The Drive & Control Company

Rexroth
Bosch Group

Axial piston variable double pump A28VO Series 10

RE 93105
Edition: 02.2018
Replaces: –.–

- Size 130
- Nominal pressure 380 bar
- Maximum pressure 420 bar
- Open circuit

Features

- Variable axial piston double pump of swashplate design for hydrostatic drives in open circuit.
- For use preferably in mobile applications eg. excavator.
- Flow is proportional to the drive speed and displacement.
- The flow can be infinitely varied by adjusting the swash-plate angle.
- One common suction port, two pressure ports.
- Special control devices program for mobile applications, with different control and regulation functions.
- Compact design for limited installation space
- High efficiency
- High power density due to increased pressure level
- Low noise level

Contents

Ordering code

01	02	03	04	05	06	07	08	09		10	11	12	13	14	15	16	17	18	19		20
A28V	**O**	**130**			**1**				**/**	**10**		**R**	**V**		**R1**	**2**			**0**	**–**	

Axial piston unit

01	Double pump, variable swashplate design	**A28V**

Operation mode

02	Pump, open circuit	**O**

Sizes (NG)

03	Geometric displacement, see “Technical data” on page 7	**130**

Pump 1: control devices: basic controller

04	Summation power controller	override hydraulic-proportional	negative control		●	**C5**
	Stroke control	override electric-proportional	positive control	U = 12 V 400 to 1200 mA	○	**E1**
				U = 24 V 200 to 600 mA	○	**E2**
				U = 24 V 400 to 1500 mA	●	**E7**

Pump 1: additional control for basic controller C5: stroke control

05	Without additional control			○	**00**
	Stroke control	override hydraulic-proportional	positive control	●	**H4**

Pump 2: control combination

06	Identical with pump 1	●	**1**

Depressurized basic position and external control pressure supply

07	Maximum swivel angle ($V_{g\ max}$)		
	Without external control pressure supply (standard for power and pressure controllers)	●	**A**
	Minimum swivel angle ($V_{g\ min}$)		
	With external control pressure supply (integrated check valve, standard for positive stroke control)	●	**C**

Connector for solenoids[1] (see page 18)

08	Without connector (only for hydraulic controls)	●	**0**
	DEUTSCH connector	●	**P**

Swivel angle indicator

09	Without sensor		●	**0**
	With electric swivel angle sensor[2] as per data sheet 95150	Power supply 5 V DC	●	**B**
		Power supply 8 V - 32 V DC	○	**K**

Series

10	Series 1, Index 0	●	**10**

● = Available ○ = On request – = Not available

1) Connectors for other electric may devate
2) Please contact us if the swivel angle sensor is use for control

01	02	03	04	05	06	07	08	09		10	11	12	13	14	15	16	17	18	19		20
A28V	**O**	**130**			**1**				**/**	**10**		**R**	**V**		**R1**	**2**			**0**	**–**	

Configuration of port and fastening threads

		130	
11	JIS (Japan), fastening threads at SAE port (working ports **A** and **S**), transport thread and through drive fastening threads are metric. Drain, meassurement and pilot pressure ports are JIS B2351.	●	**J**
	ANSI, fastening threads at SAE port (working ports **A** and **S**), transport thread and through drive fastening threads are metric. Drain, meassurement and pilot pressure ports are ISO 11926.	●	**D**

Direction of rotation

12	With view on drive shaft	clockwise	●	**R**

Sealing material

13	FKM (fluor-caoutchouc)	●	**V**

Mounting flanges

14	SAE J744	165-4	○	**E4**
	SAE J617	409-12	●	**G3**

Drive shaft (permissible input torque see page 8)

15	Splined shaft according to ANSI B92.1a	1 3/4in 13T 8/16DP	●	**R1**

Working port

16	SAE service line port $\mathbf{A_1}$, $\mathbf{A_2}$ at side, SAE-suction port **S** at bottom	●	**2**

Auxiliary pump (pilot pressure pump) and valves

17	Without integrated auxiliary pump, without pressure-relief valve	●	**K0**
	With integrated auxiliary pump, with pressure-relief valve	●	**F1**
	With integrated auxiliary pump, with pressure-relief valve and pressure reducing valve	●	**F4**

Through drive

18	Flange SAE J744			Hub for splined shaft[3]			
	Diameter	Attachment	Designation	Diameter	Designation		
	82-2 (A)	o°	A5	7/8 in 13T 16/32DP	S4	●	**A5S4**
	101-2 (B)	o-o	B2	7/8 in 13T 16/32DP	S4	●	**B2S4**
	Without through drive					●	**0000**

Speed sensor

19	Without	●	**0**

Standard/special version

20	Standard version	●	**0**
	Special version	●	**S**

Note

- Note the project planning notes on page 22.
- In addition to the ordering code, please specify the relevant technical data when placing your order.

● = Available ○ = On request – = Not available

3) According to ANSI B92.1a

Hydraulic fluids

The A28VO variable pump is designed for operation with HLP mineral oil according to DIN 51524.
Application instructions and requirements for hydraulic fluids should be taken from the following data sheets before the start of project planning:

- 90220: Hydraulic fluids based on mineral oils and related hydrocarbons
- 90221: Environmentally acceptable hydraulic fluids
- 90222: Fire-resistant, water-free hydraulic fluids (HFDR/HFDU)

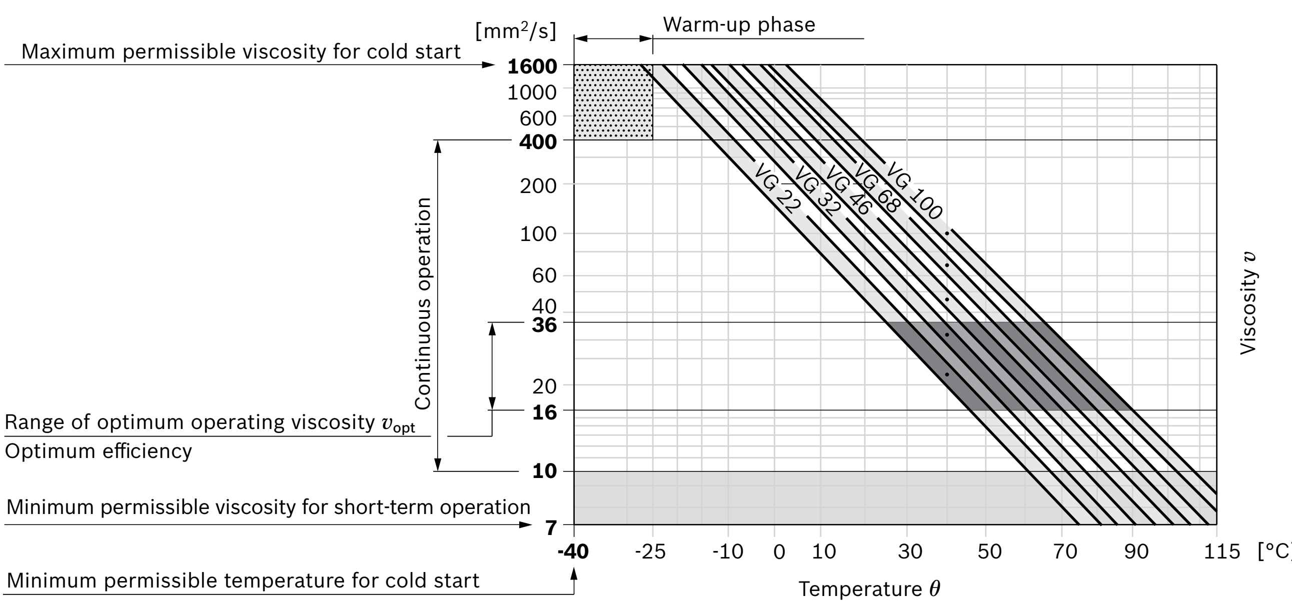
Notes on selection of hydraulic fluid
The hydraulic fluid should be selected such that the operating viscosity in the operating temperature range is within the optimum range (ν_{opt} see selection diagram).

Note
At no point of the component may the temperature be higher than 115 °C. The temperature difference specified in the table is to be taken into account when determining the viscosity in the bearing.
If the above conditions cannot be maintained due to extreme operating parameters, please contact the responsible member of staff at Bosch Rexroth.

Viscosity and temperature of hydraulic fluids

	Viscosity	Temperature	Comment
Cold start	$\nu_{max} \leq 1600$ mm²/s	$\theta_{St} \geq -40$ °C[1]	$t \leq 3$ min, without load (20 bar $\leq p \leq$ 50 bar, $n \leq 1000$ rpm
Permissible temperature difference		$\Delta T \leq 25$ K	between axial piston unit and hydraulic fluid
Warm-up phase	$\nu <$ 1600 to 400 mm²/s	θ = -40 °C to −25 °C	at $p \leq 0.7 \times p_{nom}$, $n \leq 0.5 \times n_{nom}$ and $t \leq 15$ min
Continuous operation	ν = 400 to 10 mm²/s		This corresponds, for example on the VG 46, to a temperature range of +5 °C to +85 °C (see selection diagram)
		θ = −25 °C to +110 °C	measured at port **T** Note the permissible temperature range of the shaft seal (ΔT = approx. 5 K between bearing/shaft seal and port **T**)
	ν_{opt} = 36 to 16 mm²/s		Range of optimum operating viscosity and efficiency
Short-term operation	$\nu_{min} \geq 7$ mm²/s		$t <$ 3 min, $p < 0.3 \times p_{nom}$

▼ **Selection diagram**



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1) At temperatures below −25 °C, an NBR shaft seal is required (permissible temperature range −40 °C bis +90 °C)

Filtration of the hydraulic fluid

Finer filtration improves the cleanliness level of the hydraulic fluid, which increases the service life of the axial piston unit.

In order to guarantee the functional reliability of the axial piston unit it is necessary to carry out a gravimetric evaluation of the hydraulic fluid to determine the particle contamination and the cleanliness level according to ISO 4406. A cleanliness level of at least 20/18/15 must be maintained.

At very high hydraulic fluid temperatures (90 °C to maximum 115 °C), a cleanliness class of at least 19/17/14 according to ISO 4406 is necessary.

Please contact us if the above classes cannot be observed.

Auxiliary pump

The integrated auxiliary pump of the A28VO 130 has a fixed displacement of 15 ccm. The pressure-relief valve is set at a standard value of 42 bar (lower values on request).

Inlet pressure at suction port **S_3**

- Minimum pressure $p_{S\ min:}$ X bar
- Maximum pressure $p_{S\ max:}$ X bar

An electrically proportional reducing valve can be used, for example to override the power setting (load limiting control).

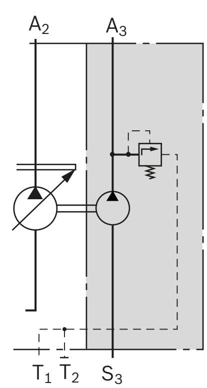
Nominal voltage of the pressure reducing valve:

- 24 V DC
- Recommended chopper frequency 200 Hz

Variation possibilities see also type code page 3

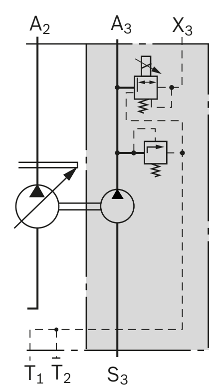
▼ **with pressure-relief valve**

.....F1



▼ **with pressure-relief valve and pressure reducing valve**

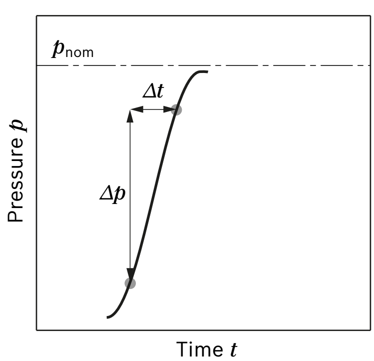
.....F4



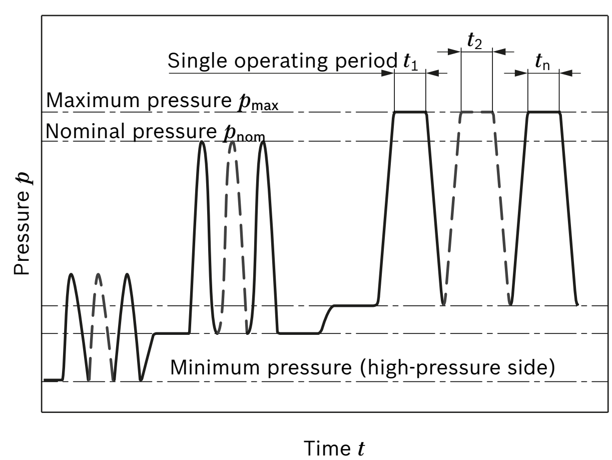
Operating pressure range

Pressure at working port A		**Definition**
Nominal pressure p_{nom}	380 bar	The nominal pressure corresponds to the maximum design pressure.
Maximum pressure p_{max}	420 bar	The maximum pressure corresponds to the maximum working pressure within the single operating period. The sum of the single operating periods must not exceed the total operating period (maximum number of cycles: approx. 1 million).
Single operating period	1 s	
Total operating period	300 h	
Minimum pressure $p_{A\ abs}$ (high-pressure side)		Minimum pressure on the high-pressure side (**A**) which is required in order to prevent damage to the axial piston unit. The minimum pressure depends on the rotational speed and the swivel angle (see diagram on page 7).
Rate of pressure change $R_{A\ max}$	16000 bar/s	Maximum permissible rate of pressure build-up and pressure reduction during a pressure change over the entire pressure range.
Pressure at suction port S (inlet)		
Minimum pressure $p_{S\ min}$	≥ 0.8 bar absolute	Minimum pressure at suction port **S** (inlet) that is required in order to avoid damage to the axial piston unit. The minimum pressure depends on the speed and displacement of the axial piston unit.
Maximum pressure $p_{S\ max}$	≤ 10 bar absolute	
Drain pressure at port T_1, T_2, T_3		
Maximum pressure $p_{L\ max}$	2.2 bar absolute	Maximum 1.2 bar higher than inlet pressure at port **S**, but not higher than $p_{L\ max}$. A case drain line to the reservoir is required.
Peak Pressure $p_{L\ peak}$	4 bar absolute	t< 0.1 s

▼ **Rate of pressure change $R_{A\ max}$**



▼ **Pressure definition**



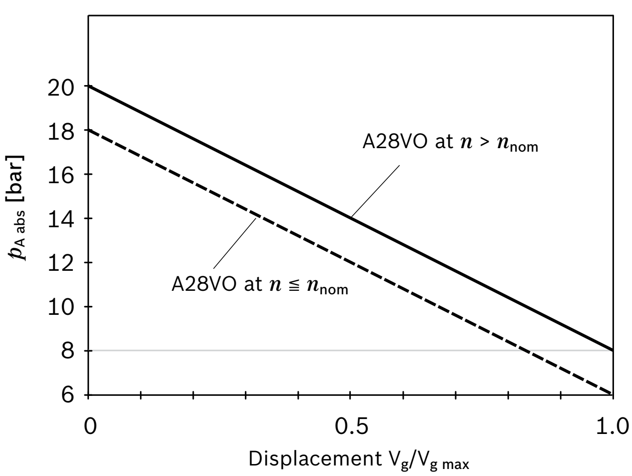
Total operating period = $t_1 + t_2 + ... + t_n$

Note
Operating pressure range valid when using hydraulic fluids based on mineral oils. Values for other hydraulic fluids, please contact us.

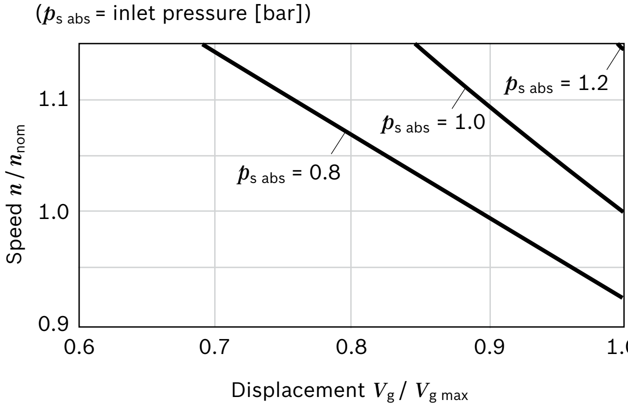
Technical data

Size		NG		130
Displacement, geometric, per revolution by rotary group		$V_{g\ max}$	cm^3	130
		$V_{g\ min}$	cm^3	0
Maximum rotational speed[1]	at $V_{g\ max}$[2]	n_{nom}	rpm	2200
	at $V_g \leq V_{g\ max}$[3]	n_{max}	rpm	2500
Flow	at n_{nom} and $V_{g\ max}$	q_v	L/min	2 x 286
Power	at n_{nom}, $V_{g\ max}$ and Δp = 380 bar	P	kW	2 x 181
Torque	at $V_{g\ max}$ and Δp = 380 bar[2]	M	Nm	2 x 756
Rotary stiffness drive shaft	1 3/4 in 13T 8/16DP R1	c	kNm/rad	220
Moment of inertia rotary group		J_{TW}	kgm^2	0.056
Maximum angular acceleration[4]		α	rad/s^2	6700
Case volume		V	L	5.3
Weight (without through drive; with auxiliary pump) approx.		m	kg	160

▼ **Minimum pressure (high-pressure side)**



▼ **Maximum permissible rotational speed (rotational speed limit)**
($p_{s\ abs}$ = inlet pressure [bar])



Determining the operating characteristics		
Flow	$q_v = \dfrac{V_g \times n \times \eta_v}{1000}$	[l/min]
Torque	$M = \dfrac{V_g \times \Delta p}{20 \times \pi \times \eta_{hm}}$	[Nm]
Power	$P = \dfrac{2\ \pi \times M \times n}{60000} = \dfrac{q_v \times \Delta p}{600 \times \eta_t}$	[kW]

Key

V_g	=	Displacement per revolution [cm^3]
Δp	=	Differential pressure [bar]
n	=	Rotational speed [rpm]
η_v	=	Volumetric efficiency
η_{hm}	=	Hydraulic mechanical efficiency
η_t	=	Total efficiency ($\eta_t = \eta_v \times \eta_{hm}$)

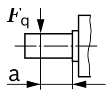
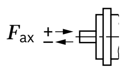
1) The values are applicable:
- for the optimum viscosity range from ν_{opt} = 36 to 16 mm^2/s
- with hydraulic fluid on the basis of mineral oils

2) The values apply at absolute pressure p_{abs} = 1 bar at suction port **S**.

3) Maximum rotational speed (rotational speed limit) in the case of increasing the inletpressure p_{abs} at suction port **S** and $V_g < V_{g\ max}$.

4) The data are valid for values between the minimum required and maximum permissible speed. Valid for external excitation (e. g. diesel engine 2 to 8 times rotary frequency; cardan shaft twice the rotary frequency). The limiting value is only valid for a single pump. The load capacity of the connection parts must be considered.

Permissible radial and axial forces of the drive shafts

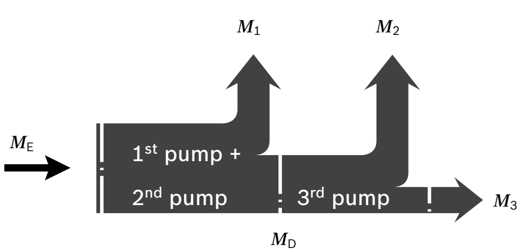
Size		NG		130
Drive shaft				1 3/4
Maximum radial force at distance a (from shaft collar)		$F_{q\,max}$	N	8000
		a	mm	33.5
Maximum axial force		$+F_{ax\,max}$	N	1200
		$-F_{ax\,max}$	N	500

Note
- Theoretical values, without efficiency and tolerances; values rounded
- Operation above the maximum values or below the minimum values may result in a loss of function, a reduced service life or in the destruction of the axial piston unit. We recommend testing the loads by means of experiment or calculation / simulation and comparison with the permissible values.
- Special requirements apply in the case of belt drives. Please contact us.

Permissible input torques

Size			NG		130
Torque at $V_{g\,max}$ and Δp = 350 bar[1]			M_{max}	Nm	1572
Input torque at drive shaft, maximum[2]					
	R1	1 3/4 in	$M_{E\,max}$	Nm	2240
Maximum through-drive torque			$M_{D\,max}$	Nm	380

▼ **Distribution of torques**



Torque at 1st pump + 2nd pump	M_1		
Torque at 3rd pump	M_2		
Torque at 4th pump	M_3		
Input torque	M_E	=	$M_1 + M_2 + M_3$
	M_E	<	$M_{E\,max}$
Through-drive torque	M_D	=	$M_2 + M_3$
	M_D	<	$M_{D\,max}$

1) Efficiency not considered
2) For drive shafts free of radial force

Power controller

C5 – Power controller with hydraulic coupling and power override through pilot pressure

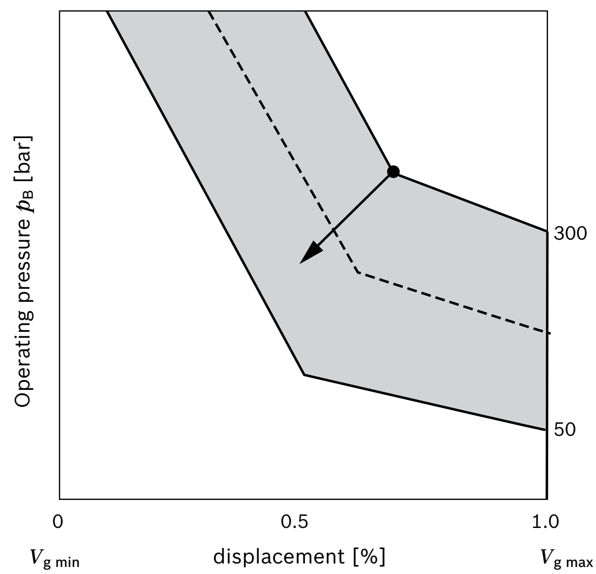
The hydraulic coupling of the two individual power controllers is the result of the accumulated power control function.
However, the two rotary groups are not coupled mechanically, but rather hydraulically.
The operating pressures of the two circuits each act on the differential piston of the two individual controllers, swiveling the two rotary groups out and back together.
If one pump is working with less than 50% of the total drive power, the remaining power can be additionally transmitted to the other pump, in borderline cases up to 100% of the total drive power.
The hyperbolic power curve is approximated with two mass springs. The operating pressure acts on the measurement area of a differential piston against the mass springs and of a spring force that can be varied from the outside, which determines the power setting.
If the sum of the hydraulic forces exceeds the forces of the springs, the control fluid is fed to the stroking piston, swiveling the pump back and setting it to a smaller volume flow.
In a depressurized state, the pump is swiveled to its initial position to $V_{g\ max}$ by a return spring.
The power override has the possibility to adjust the mechanically basic setting with a hydraulic adjustment with different pilot pressure settings.
This makes different power setting possible. The pilot pressure for power override is generated by an external control element or by the mounted pressure reducing valve.

When ordering, state in plain text:
- Application: e.g. excavator
- Drive power P [kW]
- Drive speed n [rpm]
- Maximum flow $q_{V\ max}$ [l/min]
- Maximum working pressure

Note
With the additional function hydraulic stroke limiter, each rotary group can be swiveled back independently of a smaller V_g than that currently specified by the power control.

See page 10 for the circuit diagramm of the C5H4 control

▼ **Effect of power override through pilot pressure increase**



Stroke control

H4 – Stroke limiter, hydraulic, proportional (positive control)

The hydraulic stroke limiter allows the displacement to be steplessly varied or limited over the entire adjustment range of $V_{g\,max}$ to $V_{g\,min}$.
The displacement is set by a pilot pressure.
The power control overrides the hydraulic stroke limiter control, i.e. below the power characteristic, the displacement is controlled by the pilot pressure. If the set flow or operating pressure exceeds the power characteristic, the power control overrides and reduces the displacement following the spring characteristic.

Note

The H4 characteristic is influenced by the design of the power controller!

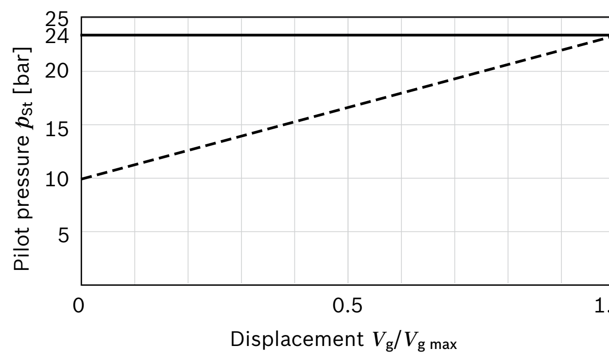
Hydraulic stroke limiter and external pilot pressure supply (positive control)

- ▶ Control from $V_{g\,min}$ to $V_{g\,max}$. With increasing pilot pressure the pump swivels to a higher displacement.

State start of control in clear text in the order.

- ▶ Initial position in depressurized state: $V_{g\,max}$

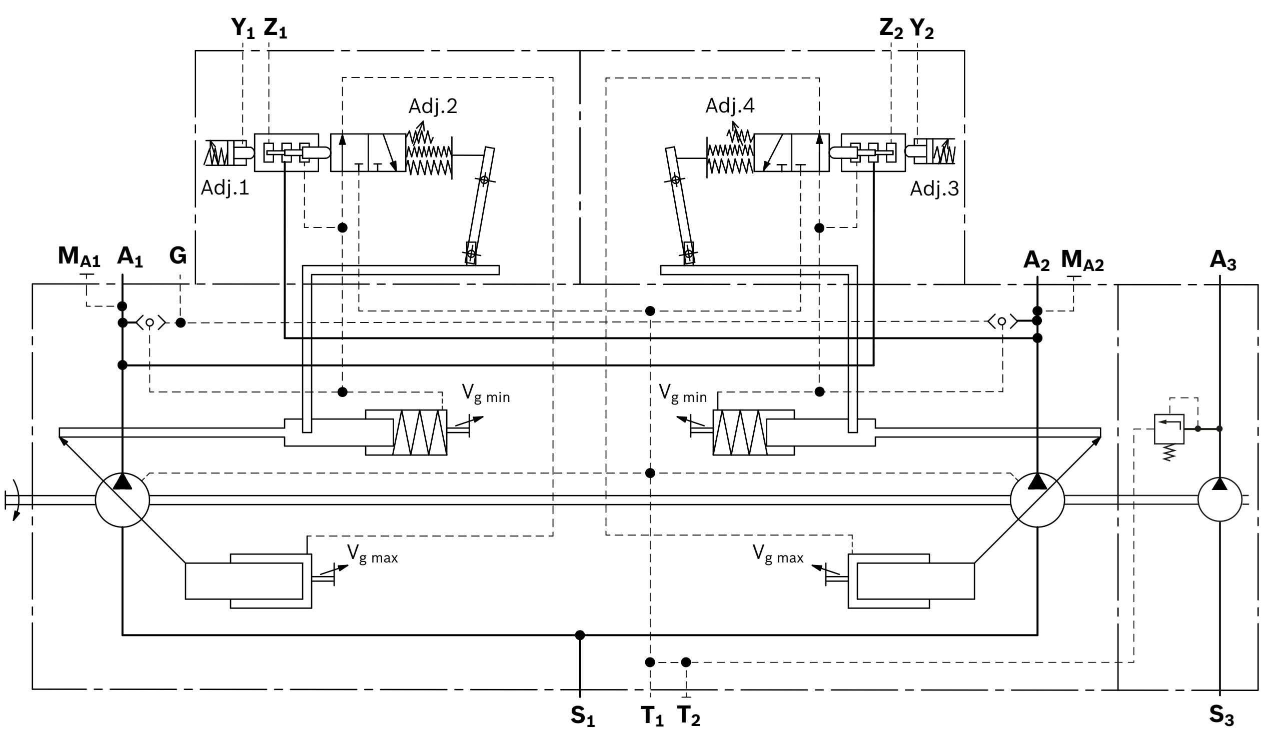
▼ **Characteristic H4**



Note

If there is no external control pressure applied to **G**, the version “Maximum swivel angle ($V_{g\,max}$), without external control pressure supply” must be ordered (see ordering code position 07, A).
If the **G** port is available, but no external control pressure applied to **G**, the **G** port must be connected to the Reservoir.

▼ **Circuit diagram C5H4**



E7 – Stroke control, electric, proportional (positive control)

With the electrical stroke limiter with proportional solenoid, the pump displacement is steplessly adjusted in proportion to the current via the magnetic force. Basic position without pilot signal is $V_{g\ min}$, which includes the mechanically depressurized basic position $V_{g\ min}$ (see ordering code position 07).

With increasing control current the pump swivels to a higher displacement (from $V_{g\ min}$ to $V_{g\ max}$).

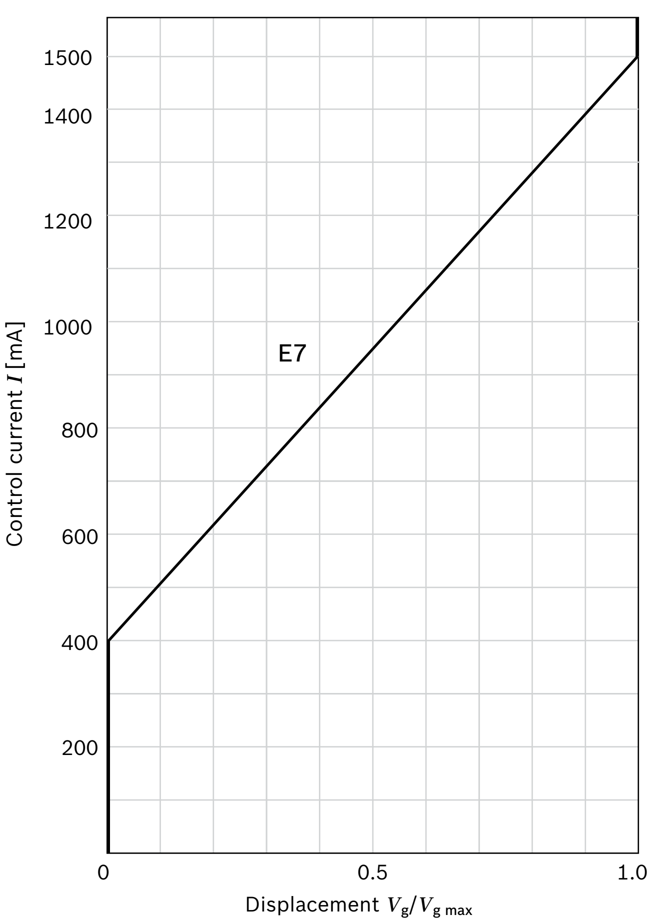
The necessary control fluid is taken from the operating pressure or the external control pressure applied to port **G**.

If the pump is to be adjusted from the basic position $V_{g\ min}$ at low operating pressure < 30 bar, port **G** must be supplied with an external control pressure of at least 30 bar, maximum 50 bar. (Circuit diagramm see page 12).

Note

If there is no external control pressure applied to **G**, the version "Maximum swivel angle ($V_{g\ max}$), without external control pressure supply" must be ordered (see ordering code position 07, A).

▼ **Characteristic E7**



BODAS RC controllers with application software and analog amplifier RA are available for controlling the proportional solenoids.

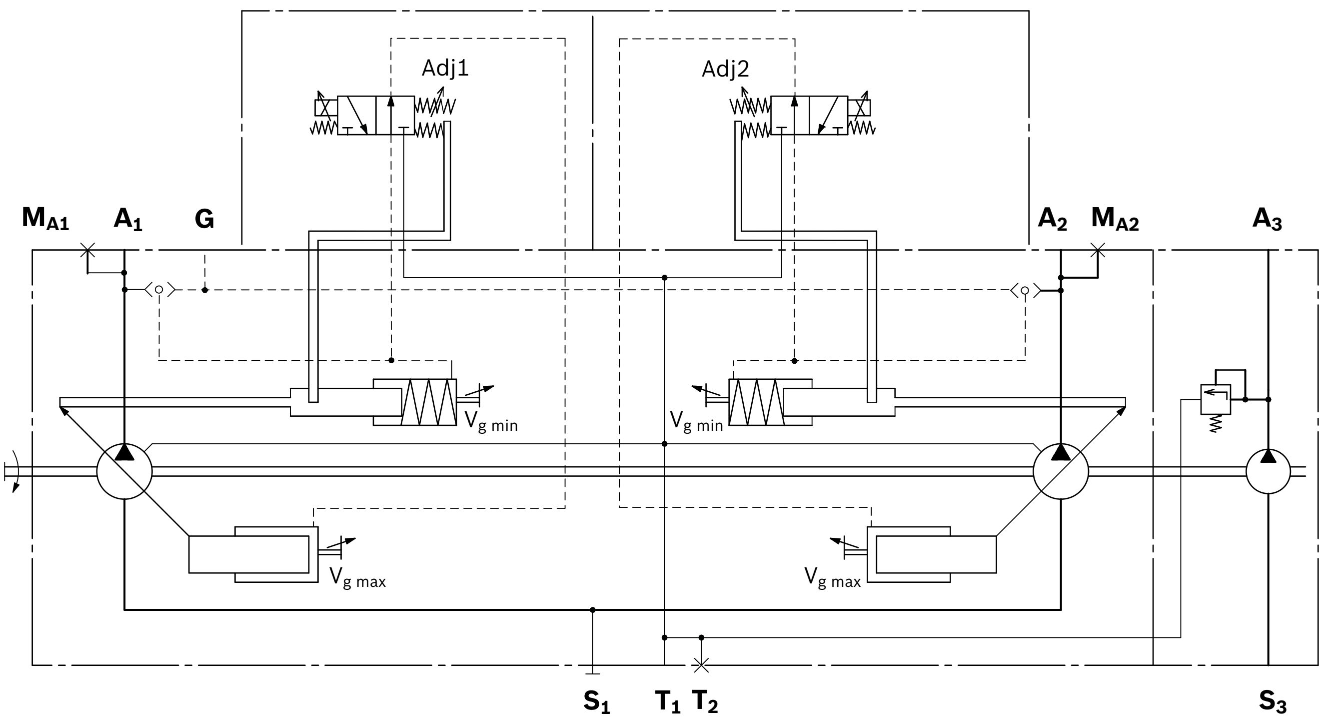
Further information can also be found on the Internet at www.boschrexroth.com/mobile-electronics.

Technical data, solenoid	E7
Voltage	24 V (±20%)
Control current	
Beginning of control at $V_{g\ min}$	400 mA
End of control at $V_{g\ max}$	1500 mA
Limiting current	1500 mA
Nominal resistance (at 20 °C)	6.5 Ω
Dither frequency	150 Hz
Duty cycle	100%
Type of protection: see connector version page 18	

When ordering, state in plain text:

- Drive speed n [rpm]
- Maximum flow $q_{V\ max}$ [l/min]
- Minimum flow $q_{V\ min}$ [l/min]

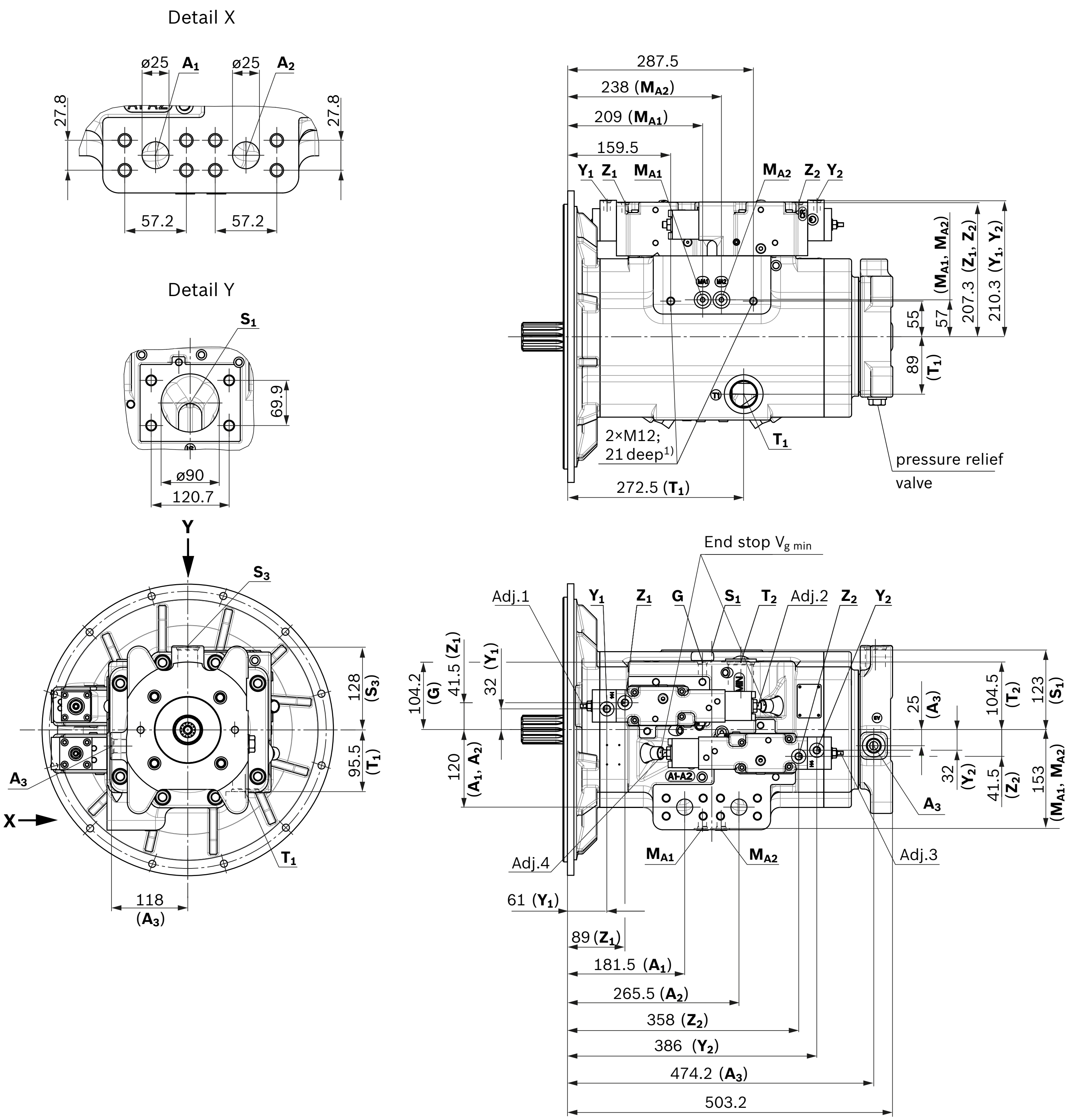
▼ **Circuit diagram E7**



Dimensions, size 130

C5H4

Clockwise rotation (Page 1/2) Additional information about ports and shaft ends can be found on page 15 and 16

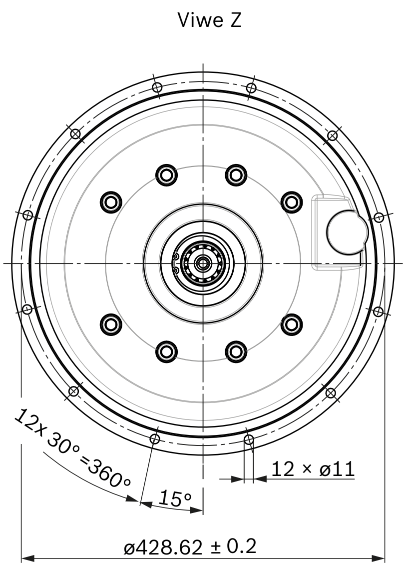


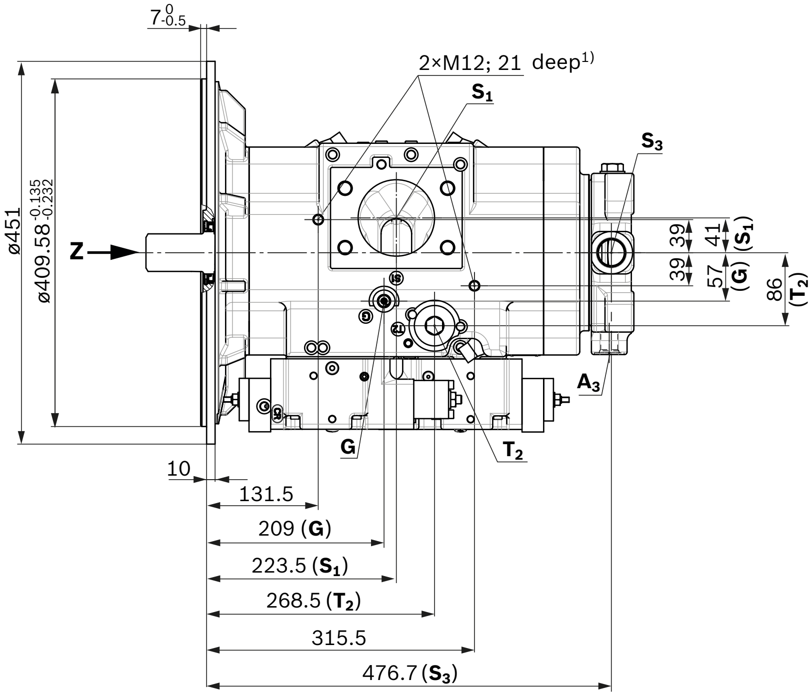
1) Thread for eye bolt

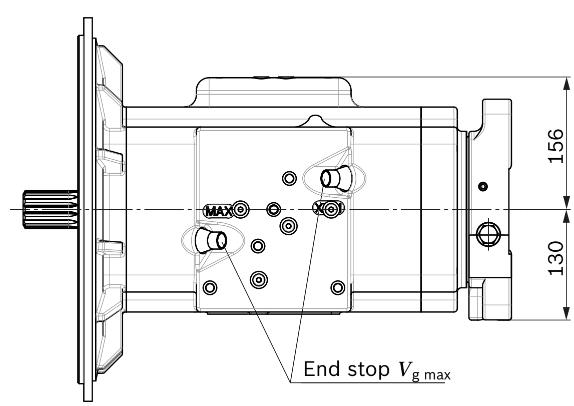
Dimensions, size 130

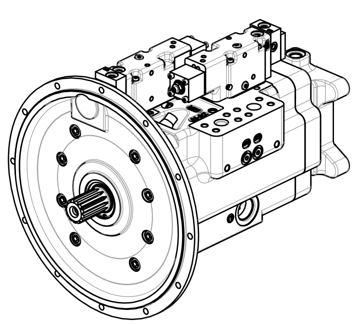
C5H4

Clockwise rotation (Page 2/2) Additional information about ports and shaft ends can be found on page 15 and 16





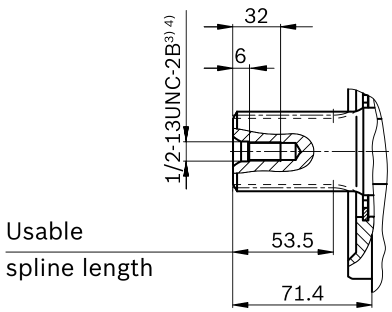




1) Thread for eye bolt

▼ **Splined shaft SAE J744**

R1 – 1 3/4 in 13T 8/16DP[1)2)]



1) ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Spline shaft according to ANSI B92.1a, run out of spline is a deviation from standard.
3) Centering bore according to DIN 332 (thread according to ASME B1.1)
4) Observe the instructions in the operating instructions concerning the maximum tightening torques.

JIS–version

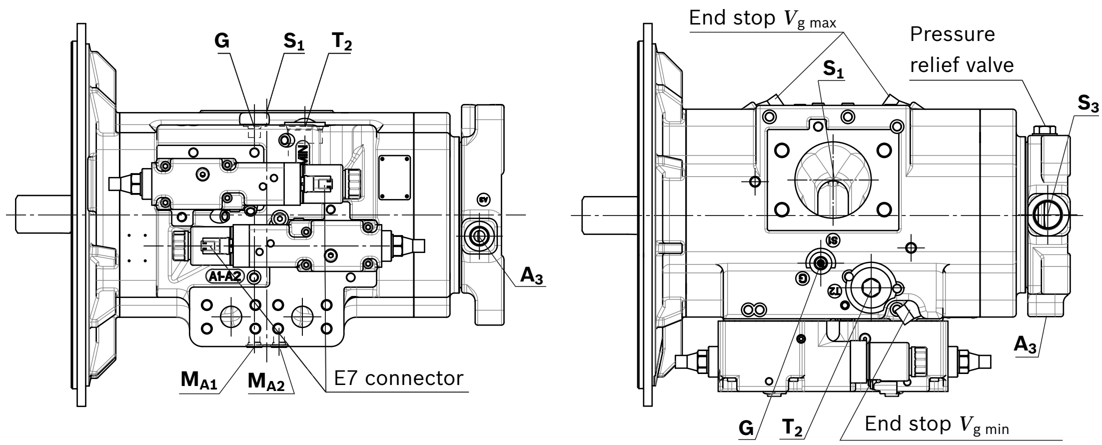
Ports			Standard	Size[4]	$p_{\text{max abs}}$ [bar][7]	State[9]	
Pump 1	**Pump 2**					**Pump 1**	**Pump 2**
A_1	A_2	Working port Fastening thread (high pressure series)	SAE J518[5)] DIN 13	1 in M12 × 1.75; 17 deep	420	O	O
S_1	–	Suction port Fastening thread (standard pressure series)	SAE J518[5)] DIN 13	3 1/2 in M16 × 2; 24 deep	10	O	–
T_1	T_1	Drain port	JIS B2351	G1 1/4; 22 deep	10	O[8)]	–
T_2	T_2	Drain port	JIS B2351	G1 1/4; 22 deep	10	X[8)]	–
Z_1	Z_2	Pilot signal (only at C5)	JIS B2351[6)]	G1/4, 13 deep	40	O	O
Y_1	Y_2	Pilot signal (only at H4)	JIS B2351[6)]	G1/4, 13 deep	40	O	O
M_{A1}	M_{A2}	Measuring, operating pressure A_1, A_2	JIS B2351[6)]	G1/4, 13 deep	420	X	X
G		External control pressure (only with external control pressure supply “C”)	JIS B2351[6)]	G1/4, 13 deep	50	O	O
Boostpump							
A_3		Working port	JIS B2351	G1/2; 17 deep	42	O	
S_3		Suction port	JIS B2351	G1; 22 deep	5	O	

SAE - version

Ports			Standard	Size[4]	$p_{\text{max abs}}$ [bar][7]	State[9]	
Pump 1	**Pump 1**					**Pump 1**	**Pump 1**
A_1	A_2	Working port Fastening thread (high pressure series)	SAE J518[5)] DIN 13	1 in M12 × 1.75; 17 deep	420	O	O
S_1	–	Suction port Fastening thread (standard pressure series)	SAE J518[5)] DIN 13	3 1/2 in M16 × 2; 24 deep	10	O	–
T_1	T_1	Drain port	ISO 11926	1 5/8-12UN-2B; 22 deep	10	O[8)]	–
T_2	T_2	Drain port	ISO 11926	1 5/8-12UN-2B; 22 deep	10	X[8)]	–
Z_1	Z_2	Pilot signal (only at C5)	ISO 11926[6)]	7/16-20UNF-2B; 13 deep	40	O	O
Y_1	Y_2	Pilot signal (only at H4)	ISO 11926[6)]	7/16-20UNF-2B; 13 deep	40	O	O
M_{A1}	M_{A2}	Measuring, operating pressure A_1, A_2	ISO 11926[6)]	9/16-18UNF-2B; 13 deep	420	X	X
G		External control pressure (only with external control pressure supply “C”)	ISO 11926[6)]	9/16-18UNF-2B; 13 deep	50	O	O
Boostpump							
A_3		Working port	ISO 11926	7/8-14UNF-2B; 17 deep	42	O	
S_3		Suction port	ISO 11926	1 5/16-12UNF-2B; 20 deep	**5**	O	

5) Metric fastening thread is a deviation from standard.
6) The spot face can be deeper than as specified in the standard
7) Depending on the application, momentary pressure peaks may occur.
Keep this in mind when selecting measuring devices and fittings.
8) Depending on installation position, T_1, T_2 or T_3 must be connected (see also Installation instructions on pages 20 and 21).
9) O = Must be connected (plugged on delivery)
X = Plugged (in normal operation)

▼ **E7** – Stroke control, electric, proportional



Connector for solenoids

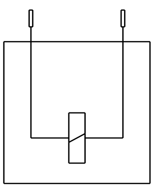
DEUTSCH DT04-2P-EP04

Molded connector, 2-pin, without bidirectional suppressor diode

There is the following type of protection with mounted mating connector:

- IP67 (DIN/EN 60529) and
- IP69K (DIN 40050-9)

▼ **Circuit diagram symbol**



▼ **Mating connector DEUTSCH DT06-2S-EP04**

Consisting of	DT designation
1 housing	DT06-2S-EP04
1 wedge	W2S
2 sockets	0462-201-16141

The mating connector is not included in the scope of delivery. This can be supplied by Bosch Rexroth on request (material number R902601804).

Changing connector orientation

Note

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

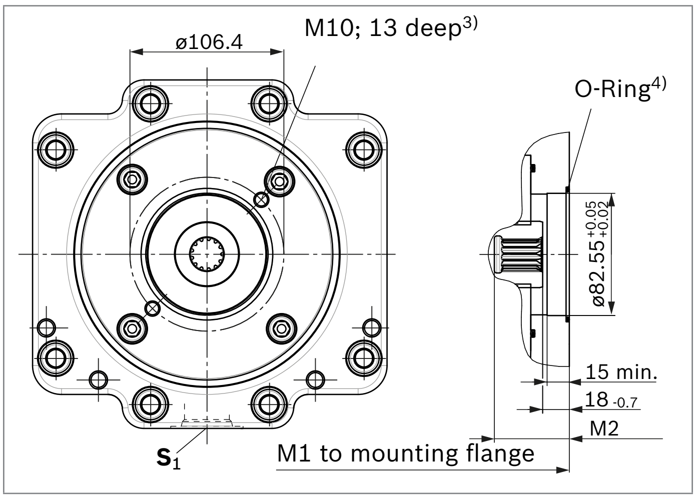
The procedure is defi ned in the instruction manual.

Dimensions, through drives

Flange SAE J744			Hub for splined shaft[1]			Availability over sizes	Code
Diameter	Attachment[2]	Designation	Diameter		Designation	130	
82-2 (A)	⚯	A5	7/8 in	13T 16/32DP	S4	●	A5S4
101-2 (B)	⚯	B2	7/8 in	13T 16/32DP	S4	●	B2S4

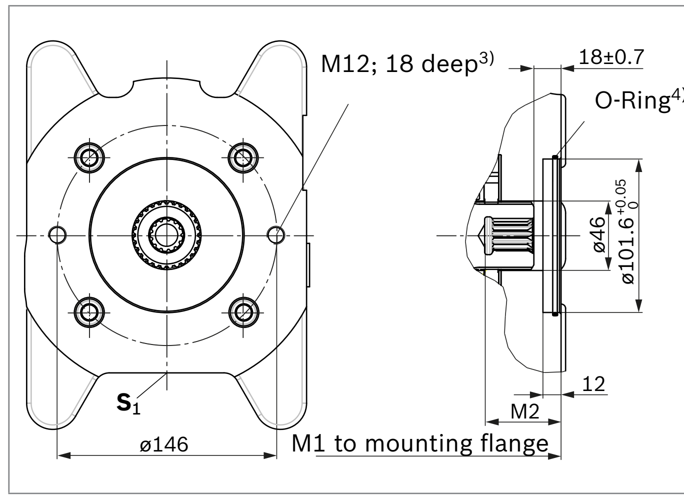
● = Available

▼ **82-2 (A)**



82-2 (A)	NG	M1	M2
without charge pump	130	470.2	50.6
with charge pump	130	500.2	50.6

▼ **101-2 (B)**



101-2 (B)	NG	M1	M2
without charge pump	130	470.2	50.6
with charge pump	130	500.2	50.6

1) According to ANSI B92.1a, 30° pressure angle, flat root, side fit, tolerance class 5
2) Mounting bores pattern viewed from through drive with control at top
3) Thread according to DIN 13, observe the instructions in the operating instructions concerning the maximum tightening torques
4) O-ring included in the scope of delivery

Installation instructions

General

The axial piston unit must be filled with hydraulic fluid and air bled during commissioning and operation. This must also be observed following a longer standstill as the axial piston unit may empty via the hydraulic lines.
Particularly in the installation position “drive shaft upwards”, filling and air bleeding must be carried out completely as there is, for example, a danger of dry running.
The case drain fluid in the case interior must be directed to the reservoir via the highest drain port (**T_1**, **T_2**, **T_3**).
For combinations of multiple units, the case drain fluid must be drained off at each pump. If a shared drain line is used for this purpose, make sure that the case pressure in each pump is not exceeded. In the event of pressure differences at the drain ports of the units, the shared drain line must be changed so that the minimum permissible case pressure of all connected units is not exceeded in any situation. If this is not possible, separate drain lines must be laid if necessary.
To achieve favorable noise values, decouple all connecting lines using elastic elements and avoid above-reservoir installation.
In all operating conditions, the suction line and drain line must flow into the reservoir below the minimum fluid level.
The permissible suction height h_S results from the overall loss of pressure. However, it must not be higher than $h_{S\ max}$ = 800 mm. The minimum suction pressure at port **S** must also not fall below 0.8 bar absolute (without charge pump) during operation and during a cold start.
When designing the reservoir, ensure adequate distance between the suction line and the case drain line. This prevents the heated, return flow from being drawn directly back into the suction line.

Note

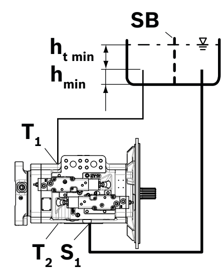
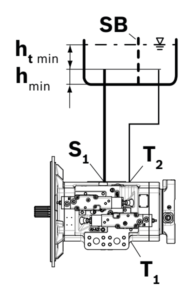
In certain installation positions, an influence on the control characteristic curves can be expected. Gravity, dead weight and case pressure can cause minor characteristic shifts and changes in response time.

Installation position

See examples **1** to **6** below.
Further installation positions are available upon request.
Recommended installation position: **1** and **2**

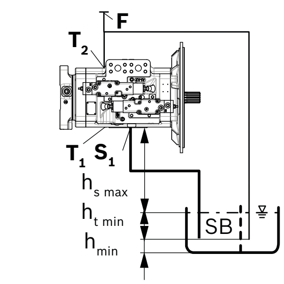
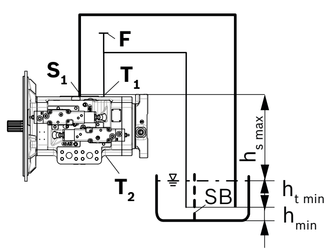
Below-reservoir installation (standard)

Below-reservoir installation is when the axial piston unit is installed outside of the reservoir and below the minimum fluid level.

Installation position	Air bleed	Filling
1  	T_1	T_1
2  	T_2	T_2

Above-reservoir installation

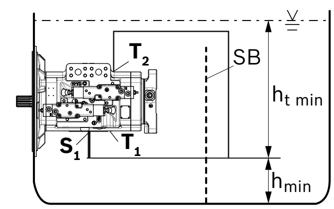
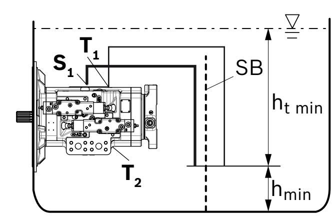
Above-reservoir installation means that the axial piston unit is installed above the minimum fluid level of the reservoir. Observe the maximum permissible suction height $h_{S\ max}$ = 800 mm.
Port **F** is part of the external piping and must be provided on the customer side to make filling and air bleeding easier.

Installation position	Air bleeding	Filling
3 	**F** (**T$_2$**)	**T$_2$** (**F**)
4 	**F** (**T$_1$**)	**T$_1$** (**F**)

Key	
F	Filling / air bleeding
S	Suction port
T	Drain port
SB	Baffle (baffle plate)
$h_{t\ min}$	Minimum required immersion depth (200 mm)
h_{min}	Minimum required distance to reservoir base (100 mm)
$h_{ES\ min}$	Minimum necessary height required to protect the axial piston unit from draining (25 mm)
$h_{S\ max}$	Maximum permissible suction height (800 mm)

Inside-reservoir installation

Inside-reservoir installation is when the axial piston unit is installed in the reservoir below the minimum fluid level. The axial piston unit is completely below the hydraulic fluid.
If the minimum fluid level is equal to or below the upper edge of the pump, see chapter **"Above-reservoir installation"**.
Axial piston units with electrical components (e.g., electric control, sensors) may not be installed in a reservoir below the fluid level.

Installation position	Air bleed	Filling
5 	via the highest available port **T$_2$**	automatically via the open port **T$_2$** due to position below hydraulic fluid level
6 	via the highest available port **T$_1$**	automatically via the open port **T$_1$** due to position below hydraulic fluid level

Note
Port **F** is part of the external piping and must be provided on the customer side to make filling and air bleeding easier.

Project planning notes

- The A28VO axial piston variable pump is designed to be used in open circuits.
- The project planning, installation and commissioning of the axial piston unit requires the involvement of qualified 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.
- The characteristic curve may also shift due to the dither frequency or control electronics.
- Preservation: Our axial piston units are supplied as standard with preservative protection for a maximum of 12 months. If longer preservative 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 in the instruction manual.
- Not all versions of the product are approved for use in a safety function according to ISO 13849. Please consult the responsible contact person at Bosch Rexroth if you require reliability parameters (e.g. $MTTF_d$) for functional safety.
- Depending on the type of control used, electromagnetic effects can be produced when using solenoids. When a direct current is applied, solenoids do not cause electromagnetic interference nor is their operation impaired by electromagnetic interference.
  Other behavior can result when a modulated direct current (e.g. PWM signal) is applied. Potential electromagnetic interference for persons (e.g. persons with a pacemaker) and other components must be tested by the machine manufacturer.
- Pressure controllers are not safeguards against pressure overload. Be sure to add a pressure relief valve to the hydraulic system.
- For drives that are operated for a long period with constant rotational speed, the natural frequency of the hydraulic system can be stimulated by the stimulator frequency of the pump (rotational speed frequency ×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 working 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 must 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 ensure any measures are properly implemented.