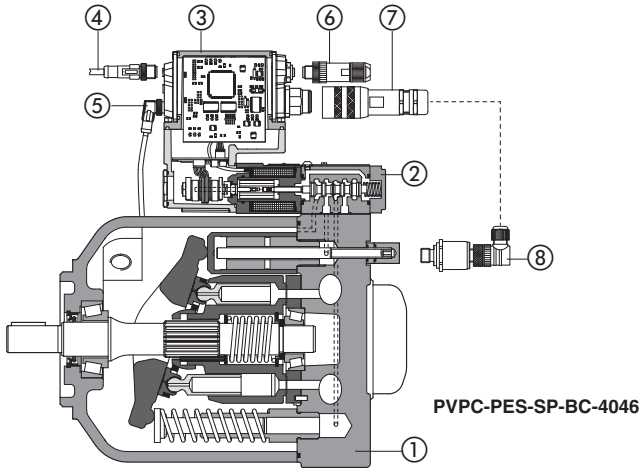
Proportional controls for PVPC pumps

analog pressure or flow, digital P/Q controls



① pumps
② proportional valve
③ integral electronics with P/Q controller
④ USB connector
⑤ swash plates transducer connection
⑥ fieldbus connector
⑦ main connector
⑧ remote pressure transducer

The variable displacement axial piston pumps type PVPC, can be supplied with advanced electrohydraulic proportional controls:

- open loop pressure control;
- open loop flow control (load sensing);
- closed loop P/Q control;

They allow to perform high dynamics and fine regulations, directly commanded from PLC or from the machine controller.
New PES digital controllers, integrated to the pump, performs alternate closed loop controls of pressure, flow and max power limitation. It is also available with optional sequence module (PERS versions) that allows to reduce close to zero the pressure to the delivery line.

SAE J744 mounting flange and shaft.
Max displacement: **29**, **46**, **73**, **88 cm³/rev**
Max pressure: **280 bar working**
350 bar peak

For technical characteristics and features, see tech table A160.

1 MODEL CODE

PVPC	X2E	-	PERS - SP	-	BC	-	4	046	/	*	/	*	/	1	D	/	*	10	/	*

Variable displacement axial piston pump

Additional suffix for double pumps
X2E = with a fixed displacement pump type PFE (see tech table A005)

Type of control (see section 7 and 8):
CZ = proportional pressure control
LQZ = prop. flow control (load sensing)
PES-SP = closed loop integral digital P/Q driver
PERS-SP = as PES plus sequence module

Fieldbus interfaces for PES and PERS:
USB interface always present
NP= Not present **BP** = PROFIBUS DP
BC= CANopen **EH** = EtherCAT

Size: **3** = for displacement 029
4 = for displacement 046
5 = for displacement 073 and 090

Max displacement:
029 = 29 cm³/rev **046** = 46 cm³/rev **073** = 73 cm³/rev **090** = 88 cm³/rev

Type of PFE (for double pumps), see tech table A005

Pressure setting (only for PERS): **200** = 200 bar **250** = 250 bar **280** = 280 bar

Options, for CZ, LQZ
see sections 3:
18 =optional coil for low current drivers

Electronics options for PES and PERS
see section 11:
C =current feedback for pressure transducer 4÷20 mA
I =current reference input and monitor 4÷20 mA (omit for standard voltage reference input and monitor ±10 V)
X =with integral pressure transducer (only for PERS)
S =with two on-off inputs for multiple pressure PID selection (NP execution) or double power supply (BC, BP and EH execution).

Direction of rotation (viewed at the shaft end)
D = clockwise **S** = counterclockwise

Shaft (SAE Standard):
1 = keyed (7/8" for 029 - 1" for 046 1 1/4" for 073 and 090)
5 = splined (13 teeth for 029 - 15 for 046 14 for 073 and 090)

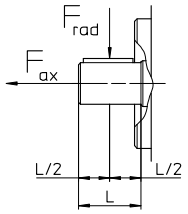
Series number

Seals material:
– = NBR
PE = FKM

2 OPERATING CHARACTERISTICS

Pump model		PVPC-*-3029	PVPC-*-4046	PVPC-*-5073	PVPC-*-5090
Displacement	[cm³/rev]	29	46	73	88
Theorical max flow at 1450 rpm	[l/min]	42	66,7	105,8	127,6
Max working pressure / Peak pressure	[bar]	280/350	280/350	280/350	250/315
Min/Max inlet pressure	[bar abs.]	0,8 / 25	0,8 / 25	0,8 / 25	0,8 / 25
Max pressure on drain port	[bar abs.]	1,5	1,5	1,5	1,5
Power consumption at 1450 rpm and at maximum pressure and displacement	[kW]	19,9	31,6	50,1	54,1
Max torque on the first shaft	[Nm]	Type1 200 / Type5 190	Type1 230 / Type5 330	Type1 490 / Type5 620	Type1 490 / Type5 620
Max permissible load on drive shaft	[N] Fax	1000	1500	2000	2000
	[N] Frad	1500	1500	3000	3000
Speed rating	[rpm]	600 ÷ 3000	600 ÷ 2600	600 ÷ 2200	600 ÷ 1850

External load position



F_{ax} = axial load
F_{rad} = radial load

Notes: For speeds over 1800 rpm the inlet port must be under oil level with adequate pipes.
Maximum pressure for all models with water glycol fluid is 160 bar, with /PE options is 190 bar.
Max speed with /PE options and water glycol fluid is 2000/1900/1600/1500 rpm respectively for the four sizes.

3 GENERAL NOTES

Atos proportional pumps are CE marked according to the applicable Directives (e.g. Immunity/Emission EMC Directive and Low Voltage Directive).
Installation, wirings and start-up procedures must be performed according to the general prescriptions shown in table F003 and in the installation notes supplied with relevant components.
The electrical signals of the pump (e.g. monitor signals) must not be directly used to activate safety functions, like to switch-ON/OFF the machine's safety components, as prescribed by the European standards (Safety requirements of fluid technology systems and components-hydraulics, EN-982).

4 MAIN CHARACTERISTICS - based on mineral oil ISO VG 46 at 50 °C

Assembly position	Any position. The drain port must be on the top of the pump. Drain line must be separated and unrestricted to the reservoir and extended below the oil level as far from the inlet as possible. Suggested maximum line lenght is 3 m.
Subplate surface finishing	Roughness index, Ra 0,4 flatness ratio 0,01/100 (ISO 1101)
Ambient temperature range	-CZ, -LQZ execution = -20°C ÷ +70°C -PES and -PERS executions = -20°C ÷ +60°C
Storage temperature range	-20°C ÷ +70°C
Coil resistance R at 20°C (CZ, LQZ)	3 ÷ 3,3 Ω for standard **12 VDC** coil; 13 ÷ 13,4 Ω for **18 VDC** coil (only for version CZ, LQZ)
	3,8 ÷ 4,1 Ω for standard **12 VDC** coil; 12 ÷ 12,5 Ω for **18 VDC** coil (only for version CZ, LQZ)
Max. solenoid current	2,6 A for standard **12 VDC** coil; 1,5 A for standard **18 VDC** coil (only for version CZ, LQZ)
Max. power	CZ, LQZ execution = 35 Watt; PES, PERS executions = 50 Watt
Power supply for pressure transducer (PE*S)	24 VDC
Insulation class	H (180°) Due to the occuring surface temperatures of the solenoid coils, the European standards ISO 13732-1 and EN982 must be taken into account
Protection degree to DIN EN60529	CZ, LQZ executions = IP65 PES, PERS executions = IP66/67
Duty factor	Continuous rating (ED=100%)
EMC, climate and mechanical load	See technical table G004

5 SEALS AND HYDRAULIC FLUID - for other fluids not included in above table, consult our technical office

Seals, recommended temperature fluid	NBR seals = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals = -20°C ÷ +80°C		
Recommended viscosity	20÷100 mm²/s - max allowed range 15 ÷ 380 mm²/s - max start-up viscosity 1000 mm²/s		
Fluid contamination class	ISO 4406 class 20/18/15 NAS 1638 class 9, in line filters of 10 μm (β10 ≥75 recommended)		
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR	HFC	

Note: for other fluids not included in above table, consult our technical office

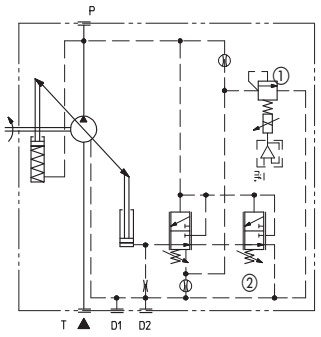
6 ELECTRONIC DRIVERS

Pump model	CZ, LQZ						PES, PERS
Drivers model	E-MI-AC-01F	E-MI-AS-IR	E-BM-AC	E-BM-AS-PS	E-ME-AC	E-RP-AC	E-RI-PES
Data sheet	G010	G020	G025	G030	G035	G100	GS215

Note: for power supply and communication connector see section 11

7 OPEN LOOP ELECTROHYDRAULIC CONTROLS

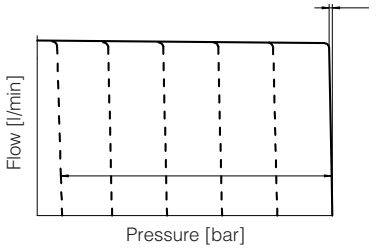
CZ



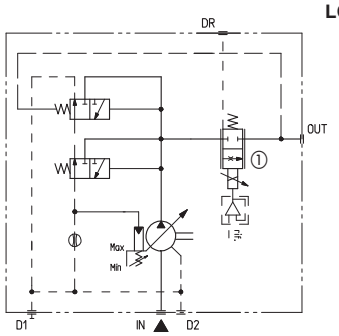
Proportional pressure control

Open loop control of the pump max pressure
The pumps displacement, and thus the flow, remains constant as far the pressure in the circuit reaches the value set on the proportional pilot valve ①, then the flow is reduced to maintain the circuit pressure to the value set by the electronic reference signal to the proportional valve. In this conditions the pressure in the circuit can be continuosly modulated by means of the reference signal.
Proportional pressure setting range: see below pressure control diagram.
Compensator setting range ②: 20÷350 bar (315 bar for 090)
Compensator factory setting ②: 280 bar (250 bar for 090)

Hysteresis and pressure increase: max 4 bar

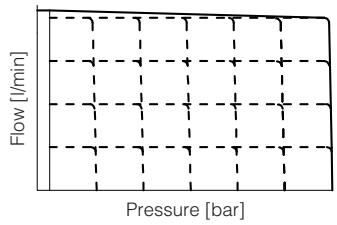


LQZ



Proportional flow (load-sensing)

Open loop control of the pump flow independent to the cyrcuit load. The pump displacement is self adjusted to maintain a costant pressure drop across the proportional flow control valve ①.
The pump flow can be continuosly regulated by modulating the proportional valve ①.

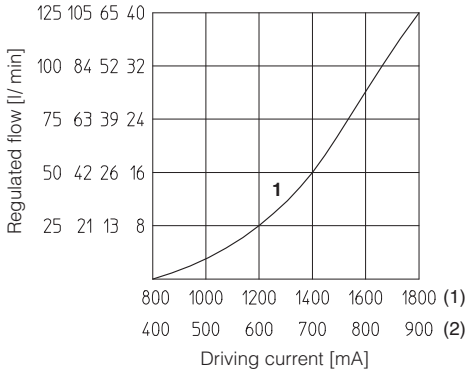


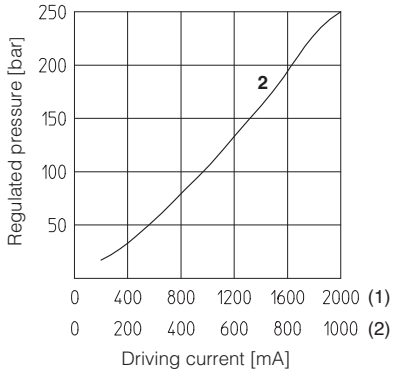
Diagrams for CZ, LQZ

Regulation diagrams
1 = Flow control
2 = Pressure control

(1) for standard 12 VDC coil
(2) for 18 VDC coil

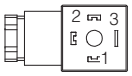
Pump size
88 73 46 29 cm³/rev





8 CONNECTIONS FOR CZ AND LQZ

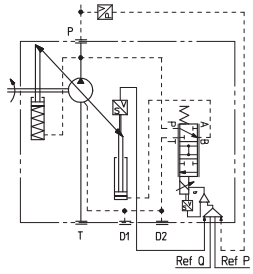
SOLENOID POWER SUPPLY CONNECTOR		
PIN	Signal description	
1	SUPPLY	
2	SUPPLY	
3	GND	



9 P/Q DIGITAL CONTROLLER

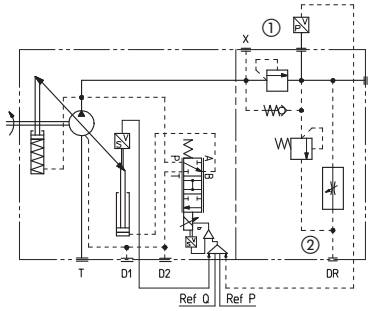
Pressure transducer not included

PES



Pressure transducer included only for PERS/X

PERS
PERS/X



Digital P/Q controller integrates the alternate pressure and flow regulation with the electronic max power limitation.
A remote pressure transducer must be installed on the system and its feedback has to be interfaced to the pump digital driver.
Flow control is active when the actual system pressure is lower than the pressure reference input signal: the pump flow is regulated according to the flow reference input.
Pressure control is activated when the actual pressure grows up to the pressure reference input signal: the pump flow is then reduced in order to regulate and limit the max system pressure (if the pressure tends to decrease under its command value, the flow control returns active). This option allows to realize accurate dynamic pressure profiles.
Following fieldbus interfaces are available:
- BC, CANopen interface
- BP, PROFIBUS DP interface
- EH, EtherCAT interface

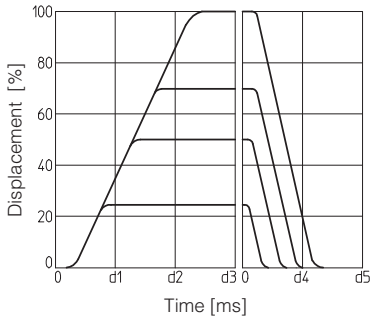
The pumps with BC, BP or EH interfaces can be integrated into a fieldbus communication network and thus digitally operated by the machine control unit.
The digital control ensures high performances as flow and pressure linearity (see diagram 1), better flow knee (see diagram 2), internal leakage compensation (controlled flow independent to the load variations).

PVPC-PES basic version, without sequence module and without pressure transducer, which has to be installed on the main line and wired to the 12 poles connector of the integral digital electronics.

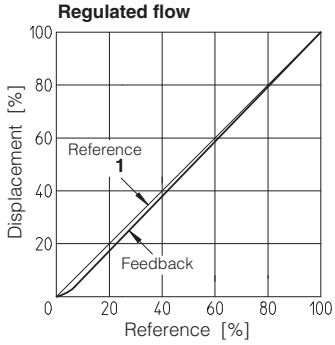
PVPC-PERS version with sequence module RESC ② which grant a minimum piloting pressure (18 bar) when the actual pressure falls below that value. Without pressure transducer.

PVPC-PERS/X as PERS version plus integral pressure transducer, with output signal 4÷20 mA, factory wired to the pump digital electronics through a cable gland.

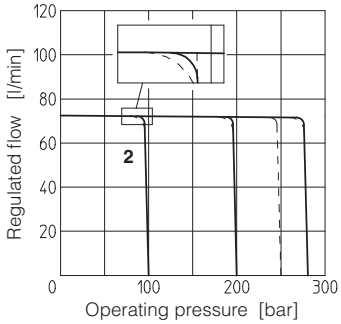
Response time



Regulated flow



P/Q control

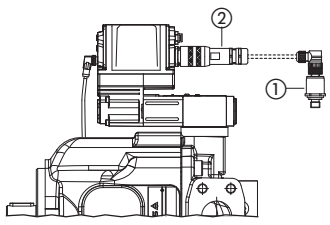


Type pump	d1	d2	d3	d4	d5
	[ms]				
PVPC-PE(R)S-3029	30	60	90	30	60
PVPC-PE(R)S-4046	40	80	120	40	80
PVPC-PE(R)S-5073	50	100	150	50	100
PVPC-PE(R)S-5090	60	120	170	60	120

Response time of displacement variation for a step change of the electronic reference signal.

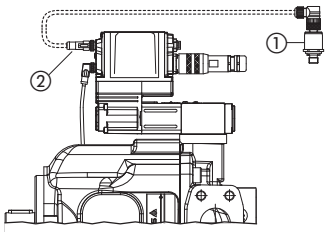
10 PRESSURE TRANSDUCER SELECTION

Standard



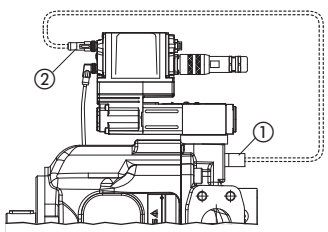
① = **remote transducer**
② = **main connector**
Note: ① and ② to be ordered separately

/S option



① = **remote transducer**
② = **M12 connector**
Note: ① and ② to be ordered separately

/X and /SX options



① = **integral transducer**
② = **M12 connector**
Note: ① and ② included

The pressure transducer type E-ATR-7 must be ordered separately (see tech table **G465**)
For /X option the pressure transducer with output signal 4 ÷ 20 mA is integral to the pump.

Pump code:	**Pressure transducer code:**
PVPC-PER(S)-*/200	E-ATR-7/250
PVPC-PER(S)-*/250	E-ATR-7/400
PVPC-PER(S)-*/280	E-ATR-7/400
PVPC-PER(S)-*/200/*/C	E-ATR-7/250/I
PVPC-PER(S)-*/250/*/C	E-ATR-7/400/I
PVPC-PER(S)-*/280/*/C	E-ATR-7/400/I

11 ELECTRONICS OPTIONS FOR PES AND PERS

Standard execution provides on the 12 pin main connector:

Power supply -The power supply must be appropriately stabilized or rectified and filtered: apply at least a 10000 μF/40 V capacitance to single phase rectifiers or a 4700 μF/40 V capacitance to three phase rectifiers.
A safety fuse is required in series to each driver power supply: 2,5 A fuse

Reference input signals -The driver controls in closed loop both the pump flow and pressure proportionally to the external reference input signals. The driver is designed to receive two analog reference input signals both referred to the common mode signal zero (AGND). The inputs range and polarity are software selectable within the ±10 VDC maximum range; default settings are 0 ÷ +10 VDC. Driver with fieldbus interface (BC or BP) can be software set to receive reference values directly by the machine control unit (fieldbus master); in this case the analog reference input signals can be used for start-up and maintenance operations.

Monitor output signals -The driver generates an analog output signals proportional to the actual pump swashplate position and to the actual pressure on the pump outlet line; the monitor output signals can be software set to show other signals available in the driver (e.g. analog reference, fieldbus reference, pilot spool position).
The output polarity is software selectable within ±10 VDC maximum range; default settings are 0 ÷ +10 VDC.

Fault Output Signal -Fault output signal indicates fault conditions of the driver (solenoid short circuits/not connected, reference signal cable broken for 4 ÷ 20mA input, pressure/swashplate/pilot transducer cable broken, etc.). Fault presence corresponds to 0 VDC, normal working corresponds to 24 VDC (pin 11 referred to pin2). Fault status is not affected by the status of the Enable input signal

Enable Input Signal (only for /S and /SX options) -To enable the driver, supply a +VDC on pin 3 referred to pin 2: when the Enable signal is set to zero the pump functioning is disabled but the driver current output stage is still active. This condition does not comply with European Norms EN954-1.

A minimum time of 300 to 500 ms have be considered between the driver energizing with the 24 VDC power supply and when the valve is ready to operate. During this time the current to the valve coils is switched to zero.

For other functions, see tech table **GS215**

11.1 Option /C

The pump electronics is set to receive 4÷20 mA feedback signal from the remote pressure transducer, instead of the standard 0÷10 V.

11.2 Option /I

It provides 4÷20 mA current reference and monitor signals instead of the standard 0÷+10 VDC.
It is normally used in case of long distance between the machine control unit and the pump or where the reference signal can be affected by electrical noise; the valve functioning is disabled in case of reference signal cable breakage.

11.3 Option /X (only for -PERS)

Option providing the presence of the pressure transducer, with output signal 4÷20 mA, integral to the pump and factory wired to the PES electronics through a cable gland.

11.4 Option /S

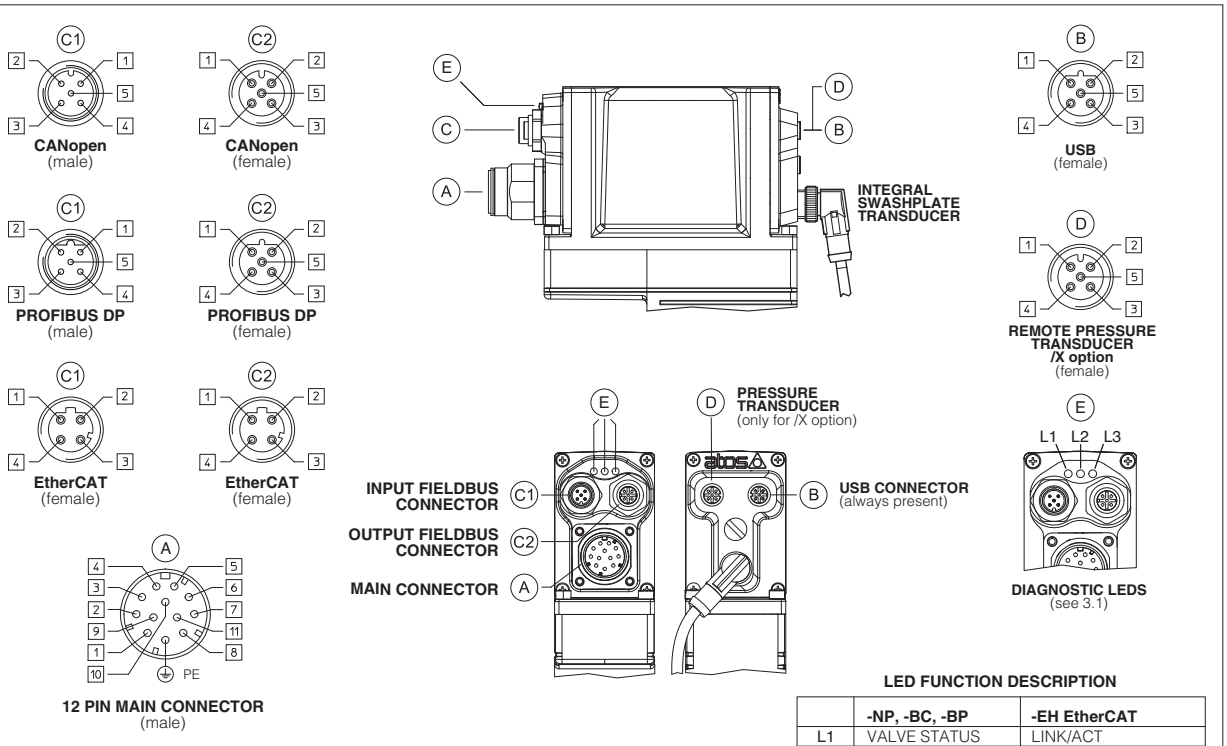
Multiple pressure PID selection (only for /S and /SX options in NP execution)
Two on-off input signals are available on the main connector to switch the active pressure PID parameters among one of the four setting stored into the driver.
Supply a 24V or a 0V on pin 9 and/or 10, to select one of the PID settings as indicated in the table beside.

	PID SET SELECTION			
PIN	**SET 1**	**SET 2**	**SET 3**	**SET 4**
9	0	24 VDC	0	24 VDC
10	0	0	24 VDC	24 VDC

Logic power supply (only for /S and /SX options in BC, BP or EH executions)
Separate power supply for the solenoid (pin 1,2) and for the digital electronic circuits (pin 9,10).
Cutting solenoid power supply allows to interrupt the valve functioning but keeping energized the digital electronics thus avoiding fault conditions of the machine fieldbus controller (e.g. for emergency, as provided by the European Norms EN954-1 for components with safety class 2).
Note: pin 2 and 10 (zero Volt) are connected together inside the electronics;

11.5 Possible combined options: /CS, /SX, /CI, /IS, /IX, /CIS and /ISX.

12 CONNECTIONS AND LEDS



Note: connectors front view

LED FUNCTION DESCRIPTION

	-NP, -BC, -BP	-EH EtherCAT
L1	VALVE STATUS	LINK/ACT
L2	NETWORK STATUS	NETWORK STATUS
L3	SOLENOID STATUS	LINK/ACT

12.1 Main connector signals (Standard, Standard with /X option) - 12 pin (A)

PIN	Standard	/X	TECHNICAL SPECIFICATIONS	NOTES
1	**V+**		Power supply 24 VDC	Input - power supply
2	**V0**		Power supply 0 VDC	Gnd - power supply
3	**FAULT**		Fault (0 VDC) or normal working (24 VDC), referred to V0	Output - on/off signal
4	**INPUT-**		Negative reference input signal for Q_INPUT+ and P_INPUT+	Gnd - analog signal
5	**Q_INPUT+**		Flow reference input signal: ±10 VDC / ±20 mA maximum range Defaults are ±10 VDC for standard and 4 ÷ 20 mA for /I option	Input - analog signal **Software selectable**
6	**Q_MONITOR**		Flow monitor output signal: ±10 VDC / ±20 mA maximum range Defaults are ±10 VDC for standard and 4 ÷ 20 mA for /I option. Referred to V0	Output - analog signal **Software selectable**
7	**P_INPUT+**		Pressure reference input signal: ±10 VDC / ±20 mA maximum range Defaults are ±10 VDC for standard and 4 ÷ 20 mA for /I option	Input - analog signal **Software selectable**
8	**P_MONITOR**		Pressure monitor output signal: ±10 VDC / ±20 mA maximum range Defaults are ±10 VDC for standard and 4 ÷ 20 mA for /I option. Referred to V0	Output - analog signal **Software selectable**
9	**D_IN**		Function software selectable between: power limitation enable (default), multiple pressure PID selection or pump enable (24 VDC) / disable (0 VDC). Referred to V0	Input - on/off signal
10	**TR+**		Remote pressure transducer input signal: ±10 VDC / ±20 mA maximum range Defaults are ±10 VDC for standard and 4 ÷ 20 mA for /C option	Input - analog signal **Software selectable**
		NC	Do not connect	
11	**TR-**		Negative pressure transducer input signal for TR+	Input - analog signal
		NC	Do not connect	
PE	**EARTH**		Internally connected to driver housing	

Note: these connections are the same of Rexroth A10VSO axial piston pumps, model SYDFEE and SYDFEC

12.2 Main connector signals (/S and /SX option) - 12 pin (A)

PIN	/S and /SX		TECHNICAL SPECIFICATIONS	NOTES
	NP	BC, BP, EH		
1	**V+**		Power supply 24 VDC	Input - power supply
2	**V0**		Power supply 0 VDC	Gnd - power supply
3	**ENABLE** referred to: V0	VL0	Enable (24 VDC) or disable (0 VDC) the pump	Input - on/off signal
4	**Q_INPUT+**		Flow reference input signal: ±10 VDC / ±20 mA maximum range Defaults are ±10 VDC for standard and 4 ÷ 20 mA for /I option	Input - analog signal **Software selectable**
5	**INPUT-**		Negative reference input signal for Q_INPUT+ and P_INPUT+	Input - analog signal
6	**Q_MONITOR** referred to: V0	VL0	Flow monitor output signal: ±10 VDC / ±20 mA maximum range Defaults are ±10 VDC for standard and 4 ÷ 20 mA for /I option	Output - analog signal **Software selectable**
7	**P_INPUT+**		Pressure reference input signal: ±10 VDC / ±20 mA maximum range Defaults are ±10 VDC for standard and 4 ÷ 20 mA for /I option	Input - analog signal **Software selectable**
8	**P_MONITOR** referred to: V0	VL0	Pressure monitor output signal: ±10 VDC / ±20 mA maximum range Defaults are ±10 VDC for standard and 4 ÷ 20 mA for /I option	Output - analog signal **Software selectable**
9	**D_IN0**		Function software selectable between: multiple pressure PID 0 selection (default) or power limitation enable. Referred to V0	Input - on/off signal
		VL+	Power supply 24 VDC for driver's logic and communication	Input - power supply
10	**D_IN1**		Function software selectable between: multiple pressure PID 1 selection (default) or power limitation enable. Referred to V0	Input - on/off supply
		VL0	Power supply 0 VDC for driver's logic and communication	Gnd - power supply
11	**FAULT** referred to: V0	VL0	Fault (0 VDC) or normal working (24 VDC)	Output - on/off signal
PE	**EARTH**		Internally connected to driver housing	

Notes: these connections are the same of Moog radial piston pumps, model RKP-D
do not disconnect VL0 before VL+ when the driver is connected to PC USB port

12.3 Communications connectors (B) - (C)

(B) **USB connector - M12 - 5 pin** always present		
PIN	**SIGNAL**	**TECHNICAL SPECIFICATION** (1)
1	**+5V_USB**	Supply for external USB Flash Drive
2	**ID**	USB Flash Drive identification
3	**GND_USB**	Signal zero data line
4	**D-**	Data line -
5	**D+**	Data line +

(C1) (C2) **BC fieldbus execution, connector - M12 - 5 pin**		
PIN	**SIGNAL**	**TECHNICAL SPECIFICATION** (1)
1	**CAN_SHLD**	Shield
2	**not used**	(C1) - (C2) pass-through connection **(2)**
3	**CAN_GND**	Signal zero data line
4	**CAN_H**	Bus line (high)
5	**CAN_L**	Bus line (low)

(C1) (C2) **BP fieldbus execution, connector - M12 - 5 pin**		
PIN	**SIGNAL**	**TECHNICAL SPECIFICATION** (1)
1	**+5V**	Termination supply signal
2	**LINE-A**	Bus line (high)
3	**DGND**	Data line and termination signal zero
4	**LINE-B**	Bus line (low)
5	**SHIELD**	

(C1) (C2) **EH fieldbus execution,connector - M12 - 4 pin**		
PIN	**SIGNAL**	**TECHNICAL SPECIFICATION** (1)
1	**TX+**	Transmitter
2	**RX+**	Receiver
3	**TX-**	Transmitter
4	**RX-**	Receiver
Housing	**SHIELD**	

Notes: (1) shield connection on connector's housing is recommended

(2): pin 2 can be fed with external +5V supply of CAN interface

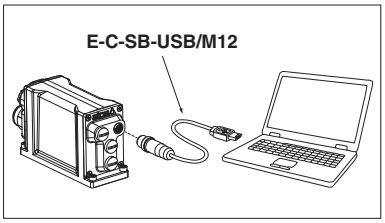
12.4 Pressure transducer connector - M12 - 5 pin - only for /S, /X, /SX options (D1) - (D2)

PIN	SIGNAL	TECHNICAL SPECIFICATION	Voltage	Current
1	**VF +24V**	Power supply +24VDC	Connect	Connect
2	**TR**	Signal transducer ±10 VDC / ±20 mA maximum range, software selectable Defaults are ±10 VDC for standard and 4 ÷ 20 mA for /C option	Connect	Connect
3	**AGND**	Common GND for transducer power and signals	Connect	/
4	**NC**	Not Connect	/	/
5	**NC**	Not Connect	/	/

13 PROGRAMMING TOOLS - see tech table **GS500**

Valve's functional parameters and configurations, can be easily set and optimized using Atos E-SW programming software connected via USB communication port to the digital driver. E-SW software is available in different versions according to the driver's fieldbus interface:
NP (not present) E-SW-PS, BC (CANopen) E-SW-BC, BP (PROFIBUS DP) E-SW-BP and EH (EtherCAT) E-SW-EH.
For fieldbus versions, E-SW software permits valve's parameterization through USB communication port also if the driver is connected to the central machine unit via fieldbus.

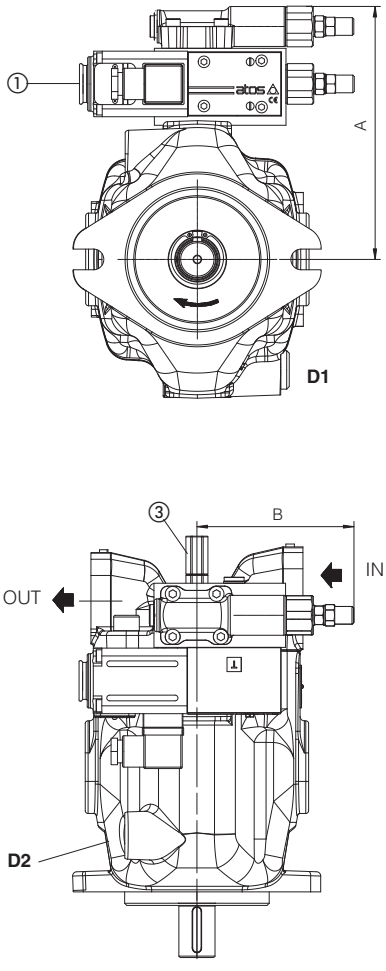
USB connection



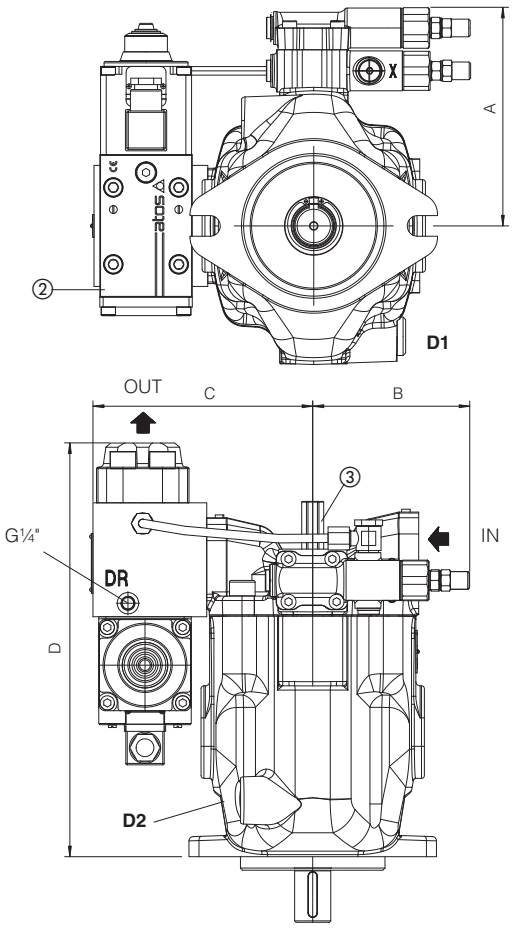
WARNING: drivers USB port is not isolated!
Use of E-A-SB-USB/OPT isolator adapter is highly recommended for PC protection.

14 DIMENSIONS OF PVPC PUMPS

PVPC-CZ



PVPC-LQZ

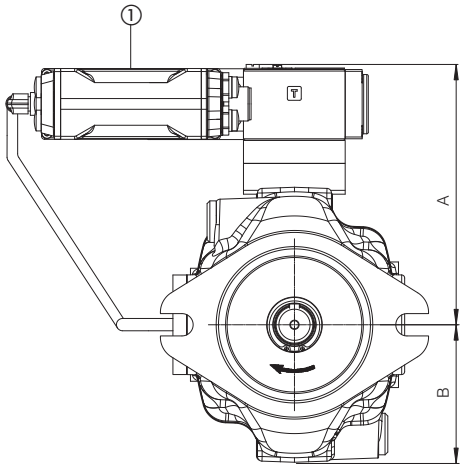


① = Proportional pressure control valve
② = Proportional flow control valve
③ = Regulation screw for max displacement. Adjustable range 50% to 100% of max displacement (not available for versions PES, PERS and PERS/X).
In case of double pump the regulation screw is not always available, please contact our technical office.

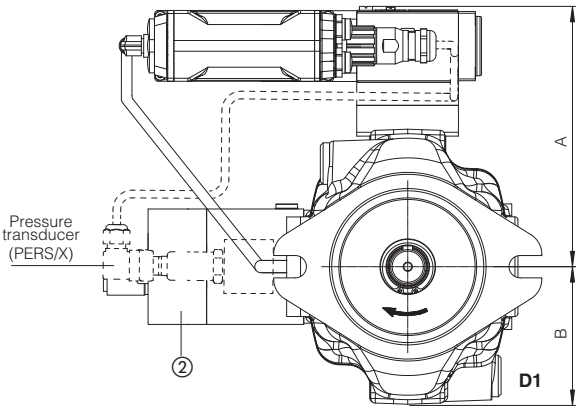
Drawing shows pumps with clockwise rotation (option D): pumps with counterclockwise rotation (option S) will have inlet and outlet ports inverted and consequently also the position of the control devices.

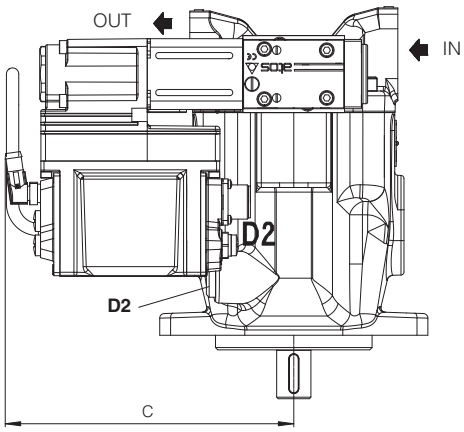
Pump type	Version	A	B	C	D	IN	OUT	D1, D2	Mass (kg)
PVPC-*-3029	**CZ**	168	111	-	-	Flange SAE 3000 1 1/2"	Flange SAE 6000 3/4"	1/2" BSPP	22
	LQZ	144	111	132	257				24
PVPC-*-4046	**CZ**	177	111	-	-	Flange SAE 3000 1 1/2"	Flange SAE 6000 1"	1/2" BSPP	28
	LQZ	153	111	156	293				33,6
PVPC-*-5073	**CZ**	190	111	-	-	Flange SAE 3000 2"	Flange SAE 6000 1 1/4"	3/4" BSPP	36,9
PVPC-*-5090	**LQZ**	166	111	163	328				44

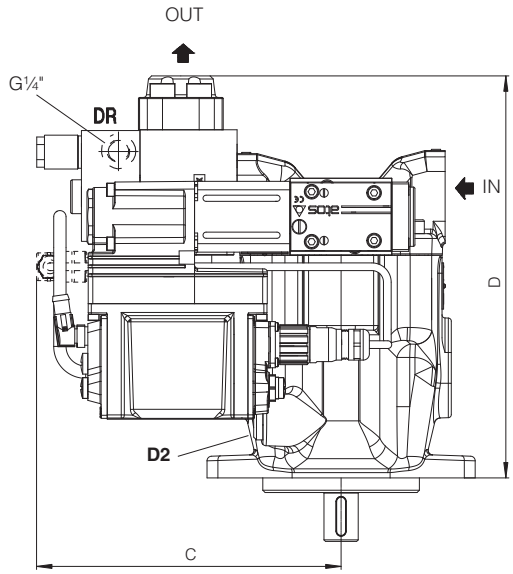
PVPC-PES



PVPC-PERS
PVPC-PERS/X (dotted line)







① = Proportional valve with integral digital P/Q controller
② = Sequence module

Drawing shows pumps with clockwise rotation (option D): pumps with counterclockwise rotation (option S) will have inlet and outlet ports inverted and consequently also the position of the control devices.

Pump type	Version	A	B	C	D	IN	OUT	D1, D2	Mass (kg)
PVPC-*-3029	**PES**	170	103,5	190	-	Flange SAE 3000 1 1/2”	Flange SAE 6000 3/4”	1/2” BSPP	21,6
	PERS	170	103,5	200	262,5				26
	PERS/X	190	103,5	200	262,5				26,4
PVPC-*-4046	**PES**	178	103,5	190	-	Flange SAE 3000 1 1/2”	Flange SAE 6000 1”	1/2” BSPP	27,6
	PERS	178	103,5	220	299				33,7
	PERS/X	178	103,5	220	299				34,1
PVPC-*-5073 PVPC-*-5090	**PES**	190	103,5	190	-	Flange SAE 3000 2”	Flange SAE 6000 1 1/4”	3/4” BSPP	36,6
	PERS	190	103,5	230	337				46,7
	PERS/X	190	103,5	230	337				47,1