Proportional controls for axial piston pumps

pressure, flow or p/Q controls, power limitation

PVPC-PES-SP-BC-4046

① Pump body
② Proportional valve
③ On-board driver with p/Q control
④ Bluetooth/USB connection
⑤ Swash plate transducer connection
⑥ Fieldbus connector
⑦ Main connector
⑧ Remote pressure transducer
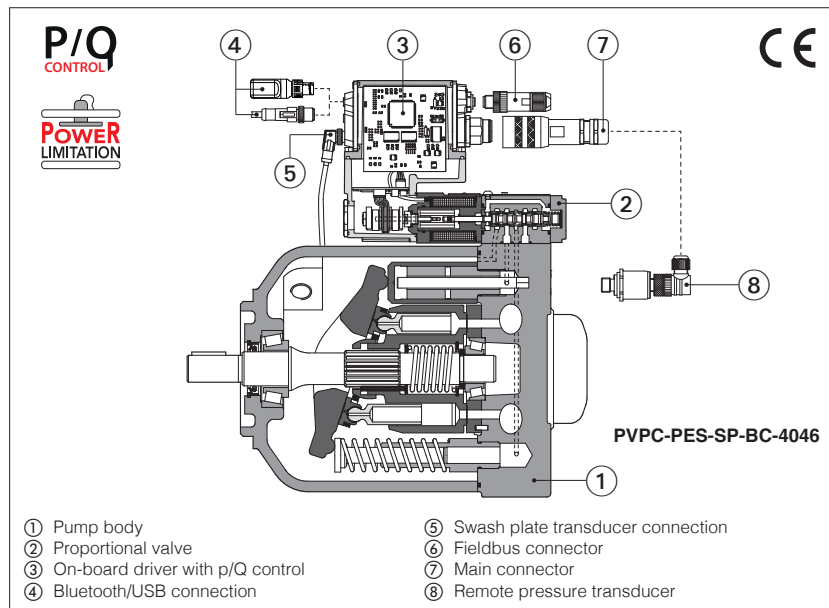
PVPC

Variable displacement axial piston pumps with swash plate design suited for high pressure open circuits, they are provided with advanced electrohydraulic proportional controls:

- **CZ** open loop pressure control
- **LQZ** open loop flow control (load sensing)
- **PES** closed loop p/Q control

PES 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 (cm³/rev)	Max pressure working (bar)	Max pressure peak (bar)
29, 46, 73	280	350
88	250	315
140	350	420
160	315	390

---

1 **MODEL CODE**

| PVPC | XA | -PES-SP | -BC | -4046/ | * | /1 | D/ | * | / | * | / | * | * | / | * |

Variable displacement axial piston pump

Option for pumps with through shaft (1) (2):
- **XA** = intermediate flange SAE A
- **XB** = intermediate flange SAE B
- **XC** = intermediate flange SAE C (only for size 5073 and 5090)

Type of control, see section 16 and 17 :
- **CZ** = proportional pressure control **(2)**
- **LQZ** = proportional flow control (load sensing) **(2)**
- **PES-SP** = closed loop on-board driver with p/Q control
- **PERS-SP** = as PES plus sequence module

Fieldbus interfaces, only for PES and PERS, see section 6 :
- **NP** = Not present
- **BC** = CANopen
- **BP** = PROFIBUS DP
- **EH** = EtherCAT
- **EW** = POWERLINK
- **EI** = EtherNet/IP
- **EP** = PROFINET RT/IRT

Size and max displacement (3):
- **3029** = size 3 - displacement 029 cm³/rev
- **4046** = size 4 - displacement 046 cm³/rev
- **5073** = size 5 - displacement 073 cm³/rev
- **5090** = size 5 - displacement 090 cm³/rev
- **6140** = size 6 - displacement 140 cm³/rev
- **6160** = size 6 - displacement 160 cm³/rev

Pressure setting, only for PERS:
- **200** = 200 bar
- **250** = 250 bar
- **280** = 280 bar
- **315** = 315 bar **(6)**
- **350** = 350 bar **(7)**

Seals material, see section 11 :
- **-** = NBR
- **PE** = FKM

Series number

Damping plate option, see section 7 :
- **V** = plate under the digital driver

Bluetooth option, see section 5 :
- **T** = Bluetooth adapter supplied with the pump

Coil voltage, for CZ, LQZ - see section 21 :
- **18** = optional coil for low current drivers

Electronic options (4):
- **C** = current feedback for pressure transducer 4÷20 mA
- **I** = current reference input and monitor 4÷20 mA
- **X** = integrated pressure transducer with pre-configured pressure settings (only for PERS)
- **S** = with 2 on-off inputs for multiple pressure PID selection for NP execution or double power supply for fieldbus execution, plus dedicated connector for remote pressure transducer

Direction of rotation, viewed at the shaft end, see section 26 :
- **D** = clockwise
- **S** = counterclockwise

Shaft, SAE Standard **(5)**:
- **1** = keyed
- **5** = splined

(1) For the LQZ and PERS versions, it must be checked that the pump to be coupled does not mechanically interfere with manifold and the OUT port of the first pump - consult our technical office
(2) Not available for PVPC size 6
(3) Optional intermediate displacements 35 and 53 cm³/rev are available on request
(4) Only for PES and PERS, for possible combined options, see section 20
(5) Pumps with ISO 3019/2 mounting flange and shaft (option /M) are available on request
(6) Only for PVPC-6160
(7) Only for PVPC-6140

2 **OFF-BOARD ELECTRONIC DRIVERS** - only for **CZ**, **LQZ**

Drivers model	E-MI-AC-01F		E-MI-AS-IR		E-BM-AS-PS		E-BM-AES
Type	Analog		Digital				
Voltage supply (VDC)	12	24	12	24	12	24	24
Valve coil option	/6	std	/6	std	/6	std	std
Format	plug-in to solenoid				DIN-rail panel		
Tech table	G010		G020		G030		GS050

3 **GENERAL NOTES**

Atos digital proportionals pumps are CE marked according to the applicable directives (e.g. Immunity and Emission EMC Directive).
Installation, wirings and start-up procedures must be performed according to the general prescriptions shown in tech table **FS900** and in the user manuals included in the E-SW-SETUP programming software.

4 **PUMP SETTINGS AND PROGRAMMING TOOLS** - see tech. table **AS800**

Free downloadable software for PC allows to set all pump functional parameters and to access complete diagnostic information of digital drivers via Bluetooth/USB service port.
Atos E-SW-SETUP PC software supports all Atos digital pump drivers and it is available at www.atos.com in MyAtos area.

⚠ **WARNING: axis card USB port is not isolated!** For E-C-SB-USB/M12 cable, the use of E-A-SB-USB/OPT isolator adapter is highly recommended for PC protection

Bluetooth or USB connection

E-A-BTH adapter

E-C-SB-USB/M12 cable

E-A-SB-USB/OPT isolator
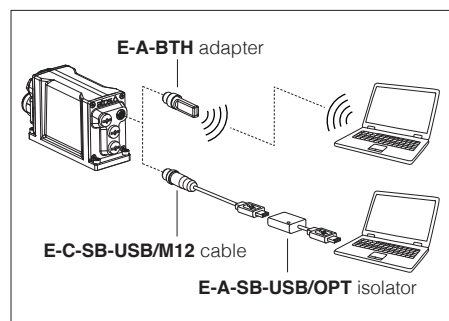
5 **BLUETOOTH OPTION** - see tech. table **AS800**

T option adds Bluetooth® connectivity to Atos pump drivers thanks to E-A-BTH adapter, which can be left permanently installed on-board, to allow the Bluetooth connection with the pump drivers at any time. E-A-BTH adapter can also be purchased separately and used to connect with any supported Atos digital product.
Bluetooth connection to the pump can be protected against unauthorised access by setting a personal password. The adapter leds visually indicates the status of pump driver and Bluetooth connection.

⚠ **WARNING:** for the list of countries where the Bluetooth adapter has been approved, see tech. table **AS800**
T option is not available for the Indian market, so the Bluetooth adapter must be ordered separately.

6 **FIELDBUS** - see tech. table **GS510**

Fieldbus allows valve direct communication with machine control unit for digital reference, valve diagnostics and settings. These execution allow to operate the valves through fieldbus or analog signals available on the main connector.

7 **DAMPING PLATE OPTION**

V option adds a rubber damping plate between the valve and the on-board digital driver to reduce acceleration mechanical stress on electronic components, consequently increasing valve life in applications with high vibrations and shocks. For more information see technical table **G004**.

8 **GENERAL CHARACTERISTICS**

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 length is 3 m.
Subplate surface finishing to ISO 4401	Acceptable roughness index: Ra ≤ 0,8, recommended Ra 0,4 – Flatness ratio 0,01/100
MTTFd values according to EN ISO 13849	150 years, for further details see technical table P007
Ambient temperature range	**CZ,LQZ:** **Standard** = -25°C ÷ +60°C **/PE** option = -15°C ÷ +80°C **PES, PERS: Standard** = -20°C ÷ +60°C **/PE** option = -20°C ÷ +60°C
Storage temperature range	**CZ,LQZ:** **Standard** = -20°C ÷ +80°C **/PE** option = -20°C ÷ +80°C **PES, PERS: Standard** = -20°C ÷ +70°C **/PE** option = -20°C ÷ +70°C
Surface protection (pump body)	Black painting RAL 9005
Surface protection (pilot valve)	Zinc coating with black passivation, galvanic treatment (driver housing)
Corrosion resistance (pilot valve)	Salt spray test (EN ISO 9227) > 200 h
Vibration resistance	See technical table G004
Compliance (proportional pilot valve)	CE according to EMC directive 2014/30/EU (Immunity: EN 61000-6-2; Emission: EN 61000-6-3) RoHS Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006

PVPC size		3029		4046		5073		5090		6140		6160	
Max displacement	(cm³/rev)	29		46		73		88		140		160	
Theoretical max flow at 1450 rpm	(l/min)	42		66,7		105,8		127,6		203		232	
Max pressure working / peak	(bar)	280 / 350		280 / 350		280 / 350		250 / 315		350 / 420		315 / 390	
Min/Max inlet pressure	(bar abs.)	0,8 / 25		0,8 / 25		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		1,5		1,5	
Power consumption at 1450 rpm and at max pressure and displacement	(kW)	20		32		52		55		120		122	
Max torque on the shaft	(shaft type) (Nm)	Type 1 210	Type 5 270	Type 1 350	Type 5 440	Type 1 670	Type 5 810	Type 1 670	Type 5 810	Type 1 1300	Type 5 1660	Type 1 1300	Type 5 1660
Max torque at max working pressure	(Nm)	128		203		328		350		780		803	
Speed rating	(rpm)	500 ÷ 3000		500 ÷ 2600		500 ÷ 2600		500 ÷ 2200		500 ÷ 2200		500 ÷ 2000	
Moment of inertia	(Kg/m²)	0,0020		0,0050		0,0030		0,0030		0,0025		0,0025	
Body volume	(l)	0,7		0,9		1,5		1,5		2,8		2,8	

10 | **ELECTRICAL CHARACTERISTICS**

Power supplies	Nominal : +24 V_{DC} Rectified and filtered : V_{RMS} = 20 ÷ 32 V_{MAX} (ripple max 10 % V_{PP})
Max power consumption	**CZ**, **LQZ** = 35 Watt; **PES**, **PERS** = 50 Watt
Max. solenoid current	2,6 A for standard **12 V_{DC}** coil; 1,5 A for standard **18 V_{DC}** coil (only for CZ, LQZ)
Coil resistance R at 20°C	**Size 3**: 3 ÷ 3,3 Ω for standard **12 V_{DC}** coil; 13 ÷ 13,4 Ω for **18 V_{DC}** coil (only for version CZ, LQZ) **Size 4, 5**: 3,8 ÷ 4,1 Ω for standard **12 V_{DC}** coil; 12 ÷ 12,5 Ω for **18 V_{DC}** coil (only for version CZ, LQZ)
Analog input signals	Voltage: range ±10 V_{DC} (24 V_{MAX} tolerant) Input impedance: R_i > 50 kΩ Current: range ±20 mA Input impedance: R_i = 500 Ω
Monitor outputs	Output range: voltage ±10 V_{DC} @ max 5 mA current ±20 mA @ max 500 Ω load resistance
Enable input	Range: 0 ÷ 5 V_{DC} (OFF state), 9 ÷ 24 V_{DC} (ON state), 5 ÷ 9 V_{DC} (not accepted); Input impedance: R_i > 10 kΩ
Fault output	Output range: 0 ÷ 24 V_{DC} (ON state > [power supply - 2 V] ; OFF state < 1 V) @ max 50 mA; external negative voltage not allowed (e.g. due to inductive loads)
Remote pressure transducer power supply	+24V_{DC} @ max 100 mA (E-ATR-8 see tech table **GS465**)
Alarms	Solenoid not connected/short circuit, cable break with current reference signal, over/under temperature, valve spool transducer malfunctions, alarms history storage function
Insulation class	H (180°) Due to the occurring 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** = IP65; **PES**, **PERS** = IP66/67 with mating connector
Duty factor	Continuous rating (ED=100%)
Tropicalization	Tropical coating on electronics PCB
Additional characteristics	Short circuit protection of solenoid's current supply; 3 leds for diagnostic; spool position control by P.I.D. with rapid solenoid switching; protection against reverse polarity of power supply
Communication interface	USB Atos ASCII coding	CANopen EN50325-4 + DS408	PROFIBUS DP EN50170-2/IEC61158	EtherCAT, POWERLINK, EtherNet/IP, PROFINET IO RT / IRT EC 61158
Communication physical layer	not insulated USB 2.0 + USB OTG	optical insulated CAN ISO11898	optical insulated RS485	Fast Ethernet, insulated 100 Base TX
Recommended wiring cable	LiYCY shielded cables, see section 25			

Note: a maximum time of 800 ms (depending on communication type) has to be considered between the driver energizing with the 24 V_{DC} power supply and when the valve is ready to operate. During this time the current to the valve coils is switched to zero.

11 SEALS AND HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C		
Recommended viscosity	20÷100 mm²/s - max allowed range 15 ÷ 380 mm²/s		
Max fluid contamination level	normal operation	ISO4406 class 18/16/13 NAS1638 class 7	see also filter section at
	longer life	ISO4406 class 16/14/11 NAS1638 class 5	www.atos.com or KTF catalog
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

12 PERFORMACE RESTRICTIONS WITH FLAME RESISTANT FLUIDS

12.1 HFDU and HFDR - Phosphate ester

PVPC size		3029	4046	5073	5090	6140	6160
Max pressure working / peak	(bar)	200 / 240					
Max speed	(1) (rpm @ V$_{MAX}$)	2050	1850	1700	1550	**(2)**	
Ambient temperature range	(°C)	-10 ÷ +80					
Bearing life (% of bearing life with mineral oil)	(%)	90					

(1) With an inlet pressure of 1 bar abs
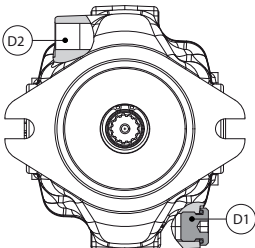**(2)** For information about size 6140 and 6160, contact Atos technical office
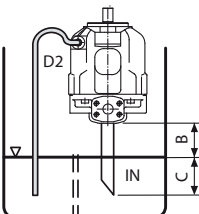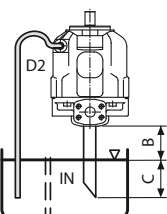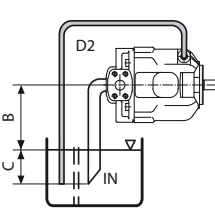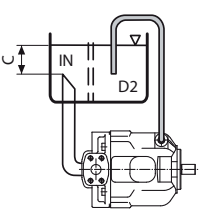
12.2 HFC - Water-glycol (35 ÷ 55 % of water)

PVPC size		3029	4046	5073	5090	6140	6160
Max pressure working / peak	(bar)	180 / 210					
Max speed	(1) (rpm @ V$_{MAX}$)	2050	1850	1700	1550	**(2)**	
Ambient temperature range	(°C)	-10 ÷ +60					
Bearing life (% of bearing life with mineral oil)	(%)	40					

(1) With an inlet pressure of 1 bar abs
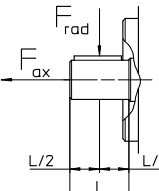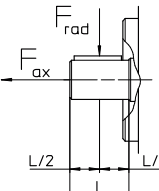**(2)** For information about size 6140 and 6160, contact Atos technical office

13 INSTALLATION POSITION

The pump is supplied with drain D2 open, and D1 plugged. Before installation fill the pump with hydraulic oil for at least 3/4 of its volume, keeping it in horizontal position.
With exception of pump mounted below the oil level, we recommend to interpose a baffle plate between inlet and drain line.

VERTICAL INSTALLATION

INSIDE THE TANK
Minimum oil level below the pump mounting surface.
Minimum inlet pressure = 0,8 bar absolute
B ≤ 800mm, C= 200mm

OUTSIDE THE TANK, above oil level
Minimum inlet pressure = 0,8 bar absolute
B ≤ 800mm, C= 200mm

HORIZONTAL INSTALLATION

OUTSIDE THE TANK, above oil level
Minimum inlet pressure = 0,8 bar (absolute)
B ≤ 800mm, C= 200mm

OUTSIDE THE TANK, below oil level
C= 200mm

IN: inlet line - **D2:** drain line - **B+C:** permissible suction height - **C:** inlet line immersion dept

14 MAX PERMESSIBLE LOAD ON DRIVE SHAFT

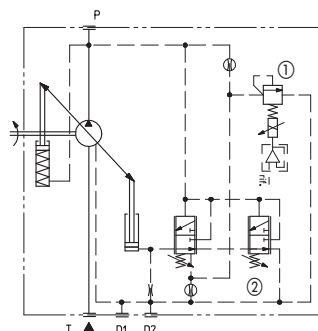| PVPC size		3029	4046	5073	5090	6140	6160
F$_{ax}$ = axial load	N	1000	1500	2000	2000	2000	2000
F$_{rad}$ = radial load	N	1500	1500	3000	3000	3000	3000

15 VARIATION OF MAX SPEED VS INLET PRESSURE

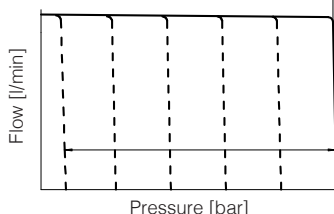| Inlet pressure	Displacement %					
bar abs.	65	70	80	90	100	
0,8	120	115	105	97	90	% variation of the max. speed
0,9	120	120	110	103	95	
1,0	120	120	115	107	100	
1,2	120	120	120	113	106	
1,4	120	120	120	120	112	
1,6	120	120	120	120	117	
2,0	120	120	120	120	120	

Example
Displacement: 80% - Inlet pressure: 1,0 bar - Speed: 115%

16 OPEN LOOP ELECTROHYDRAULIC CONTROLS

CZ - Proportional pressure control


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

Hysteresis and pressure increase: max 4 bar

Regulation diagram
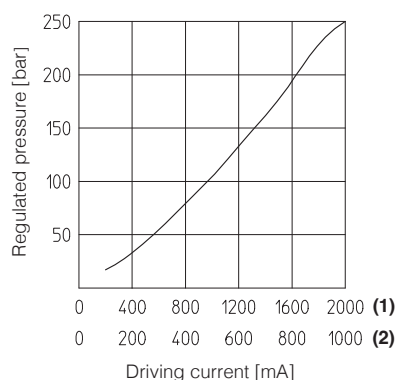
(1) for standard 12 V_{DC} coil
(2) for optional 18 V_{DC} coil

LQZ - Proportional flow (load-sensing) control
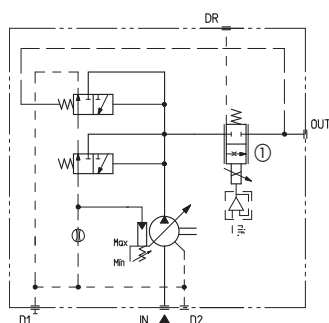
Pump with flow rate load sensing proportional control. The pump displacement is self adjusted to maintain a costant pressure drop across the proportional flow control valve ① independently from the load.
The pump flow can be continuosly regulated by modulating the proportional valve ①.

Regulation diagrams

Pump size
88 73 46 29 cm³/rev

(1) for standard 12 V_{DC} coil
(2) for optional 18 V_{DC} coil

PES - closed loop

Pressure transducer not included

The p/Q control algorithm automatically selects which control, between pressure and flow rate is active.

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.

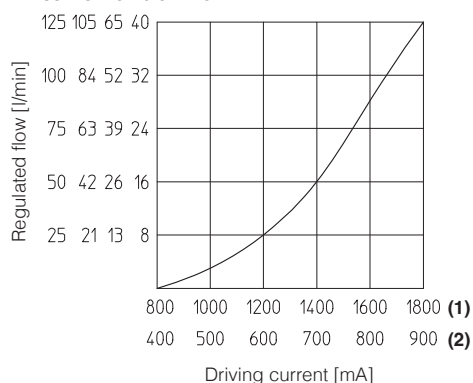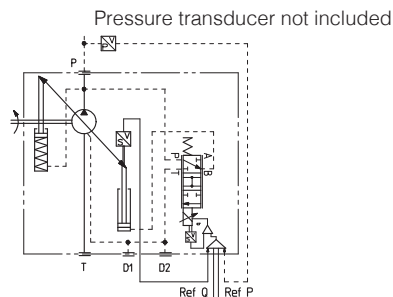Pressure control is activated when the actual pressure grows up to the pressure reference input signal: the pump flow is then reduced in order to regulate and limit the max system pressure (if the pressure tends to decrease under its command value, the flow control returns active).

PVPC-PES needs a remote pressure transducer to be installed on the system and its feedback has to be interfaced to the pump on-board digital driver, through the 12 poles connector.

PERS - as PES, plus sequence module
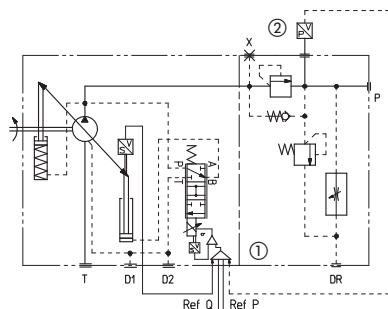
PVPC-PERS as PES version plus sequence module RESC ① which:

• grants a minimum piloting pressure (18 bar) when the actual pressure falls below that value:

• integrates a safety relief valve

• allows to depressure the line through a compensated oil drain.

The **/X** option allows to integrate on the RESC module a integrated pressure transducer ②, with output signal 4÷20 mA, factory wired to the pump on-board digital driver.

p/Q control

Regulated flow
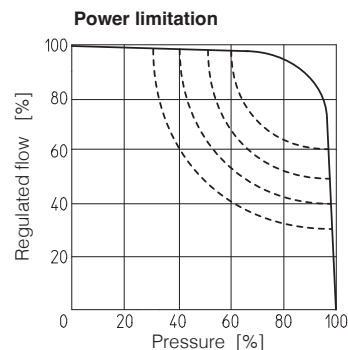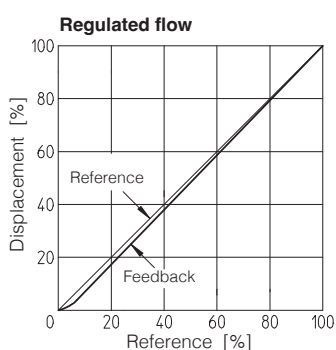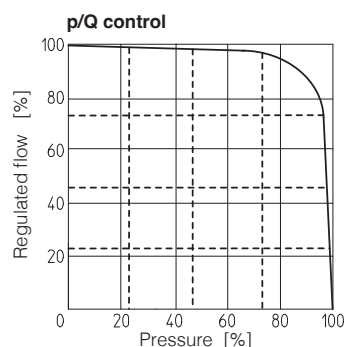
Power limitation

The power limitation algorithm allows to limit the hydraulic power of the pump to the value set via software or fieldbus see section 22.12

Response time

Displacement variation response time for a step change of the flow rate reference signal.
The indicated times refer to tests performed with a pilot pressure of 50 bar.
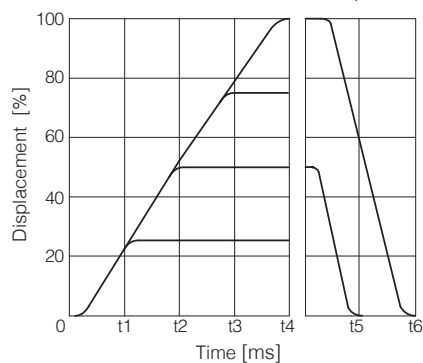
Pump type	0-25%	0-50%	0-75%	0-100%	50-0%	100-0%
	t1 [ms]	**t2** [ms]	**t3** [ms]	**t4** [ms]	**t5** [ms]	**t6** [ms]
PVPC-PE(R)S-3029	30	45	60	75	20	40
PVPC-PE(R)S-4046	40	60	80	100	30	60
PVPC-PE(R)S-5073	50	70	100	125	40	75
PVPC-PE(R)S-5090	60	80	115	140	45	90
PVPC-PE(R)S-6140	85	125	145	170	75	165
PVPC-PE(R)S-6160	95	135	160	185	85	180

REMOTE PRESSURE TRANSDUCER SELECTION

The pressure transducer type E-ATR-8 must be ordered separately (see tech table **GS465**), except for /X and /SX options for which the pressure transducer with output signal 4 ÷ 20 mA is integrated to the pump.

Pump code	Pressure transducer code	Pump code	Pressure transducer code
PVPC-PE(R)S-*/200	E-ATR-8/250	PVPC-PE(R)S-*/200/*/C	E-ATR-8/250/I
PVPC-PE(R)S-*/250	E-ATR-8/400	PVPC-PE(R)S-*/250/*/C	E-ATR-8/400/I
PVPC-PE(R)S-*/280	E-ATR-8/400	PVPC-PE(R)S-*/280/*/C	E-ATR-8/400/I
PVPC-PE(R)S-*/315	E-ATR-8/400	PVPC-PE(R)S-*/315/*/C	E-ATR-8/400/I
PVPC-PE(R)S-*/350	E-ATR-8/400	PVPC-PE(R)S-*/350/*/C	E-ATR-8/400/I

19 **ELECTRONIC OPTIONS** - only for **PES** and **PERS**

I = This option provides 4 ÷ 20 mA current reference and monitor signals, instead of the standard 0 ÷ 10 VDC.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ±20 mA.
This option is normally used in case of long distance between the machine control unit and the valve or where the reference signal can be affected by electrical noise; the valve functioning is disabled in case of reference signal cable breakage.

C = This option is available to connect pressure transducers with 4 ÷ 20 mA current output signal, instead of the standard 0 ÷ 10 VDC.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ±20 mA.

X = This option includes the pressure transducer, with output signal 4 ÷ 20 mA, integrated to the pump and factory wired to the pilot valve electronic (see 22.10).

S = Two on-off input signals are available on the main connector to select one of the four pressure PID parameters setting, stored into the driver (see 22.11).

20 **POSSIBLE COMBINED OPTIONS**

For **PES**:
/CI, /CS, /IS, /CIS

For **PERS**:
/CI, /CS, /IS, /IX, /SX, /CIS, /ISX

Note: **/T** Bluetooth adapter option and **/V** damping plate option can be combined with all other options

21 **COIL VOLTAGE OPTION** - only for **CZ** and **LQZ**

18 = Optional coil to be used with electronic drivers not supplied by Atos, with power supply 24 VDC and with max current limited to 1A.

22 **POWER SUPPLY AND SIGNALS SPECIFICATIONS** - only for **PES** and **PERS**

Generic electrical output signals of the pump (e.g. fault or 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, ISO 4413).

22.1 Power supply (V+ and V0)
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. In case of separate power supply see 22.2.

⚠ A safety fuse is required in series to each power supply: 2,5 A time lag fuse.

22.2 Power supply for driver's logic and communication (VL+ and VL0) - only for **/S** and **/SX** options for fieldbus executions
The power supply for driver's logic and communication 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.
The separate power supply for driver's logic on pin 9 and 10, allow to remove solenoid power supply from pin 1 and 2 maintaining active the diagnostics, USB and fieldbus communications.

⚠ A safety fuse is required in series to each driver's logic and communication power supply: 500 mA fast fuse.

22.3 Flow reference input signal (Q_INPUT+)
Functionality of Q_INPUT+ signal, is used as reference for the pump's flow.
Reference input signal is factory preset according to selected valve code, defaults are 0 ÷ 10VDC for standard and 4 ÷ 20 mA for /I option.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.
Drivers with fieldbus interface can be software set to receive reference signal directly from the machine control unit (fieldbus reference). Analog reference input signal can be used as on-off commands with input range 0 ÷ 24VDC.

22.4 Pressure reference input signal (P_INPUT+)
Functionality of P_INPUT+ signal, is used as reference for the driver pressure closed loop.
Reference input signal is factory preset according to selected valve code, defaults are 0 ÷ 10VDC for standard and 4 ÷ 20 mA for /I option.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.
Drivers with fieldbus interface can be software set to receive reference signal directly by the machine control unit (fieldbus reference).
Analog reference input signal can be used as on-off commands with input range 0 ÷ 24VDC.

22.5 Flow monitor output signal (Q_MONITOR)
The driver generates an analog output signal proportional to the actual pump swashplate position; the monitor output signal can be software set to show other signals available in the driver (e.g. analog reference, fieldbus reference, pilot spool position).
Monitor output signal is factory preset according to selected pump code, defaults are 0 ÷ 10VDC for standard and 4 ÷ 20 mA for /I option.
Output signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.

22.6 Pressure monitor output signal (P_MONITOR)
The driver generates an analog output signal proportional to alternated pressure/force control; the monitor output signal can be software set to show other signals available in the driver (e.g. analog reference, force reference).
Monitor output signal is factory preset according to selected pump code, defaults are 0 ÷ 10VDC for standard and 4 ÷ 20 mA for /I option.
Output signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.

22.7 Enable input signal (ENABLE) - only for **/S** and **/SX** options
To enable the driver, supply a 24 VDC on pin 3 (pin C): Enable input signal allows to enable/disable the current supply to the solenoid, without removing the electrical power supply to the driver; it is used to active the communication and the other driver functions when the valve must be disabled for safety reasons. This condition **does not comply** with norms IEC 61508 and ISO 13849.
Enable input signal can be used as generic digital input by software selection.

22.8 Fault output signal (FAULT)
Fault output signal indicates fault conditions of the driver (solenoid short circuits/not connected, reference signal cable broken for 4 ÷ 20 mA input, spool position transducer cable broken, etc.). Fault presence corresponds to 0 VDC, normal working corresponds to 24 VDC.
Fault status is not affected by the Enable input signal. Fault output signal can be used as digital output by software selection.

22.9 Pressure transducer input signal

Analog pressure transducers can be directly connected to the driver.
Analog input signal is factory preset according to selected pump code, defaults are 0 ÷ 10 VDC for standard and 4 ÷ 20 mA for /C option.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.
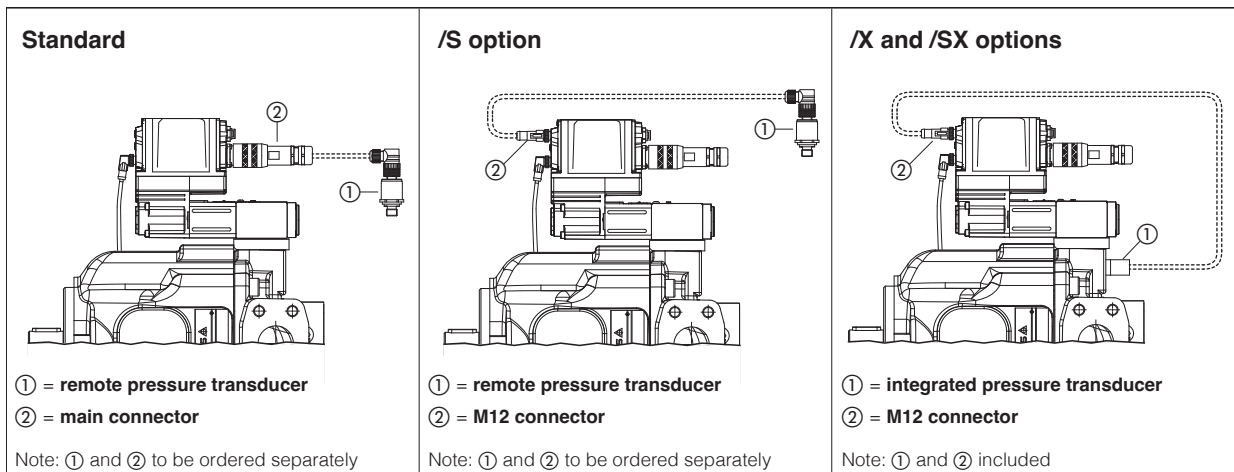Standard:
Remote pressure transducer can be directly connected to the driver main connector (see 23.1)
/S option
Remote pressure transducer can be directly connected to a dedicated M12 connector on the driver (see 23.4)
/X and /SX options
Pump integrated pressure transducer is directly connected with a dedicated M12 connector and no remote pressure transducer is required; current input signal (4 ÷ 20 mA) of the transducer allows cable break detection functionality

Standard	/S option	/X and /SX options
① = **remote pressure transducer** ② = **main connector** Note: ① and ② to be ordered separately	① = **remote pressure transducer** ② = **M12 connector** Note: ① and ② to be ordered separately	① = **integrated pressure transducer** ② = **M12 connector** Note: ① and ② included

22.10 Logic Input Signal (D_IN) - only for **standard** and **standard** with **/X** option

D_IN on-off input signal can be software set to perform one of the following functions:
- enable and disable the power limitation function; default setting, apply 0VDC to disable and 24VDC to enable the power limitation - see 22.12
- enable and disable the driver functioning; apply 0 VDC to disable and 24 VDC to enable the driver - see 22.7
- switch between two pressure PID settings - see 22.11

22.11 Multiple pressure PID (1)

Four sets for pressure PID parameters are stored into the driver: switching in real-time the active pressure PID parameters during machine cycle allows to optimize the system dynamic response in different hydraulic working conditions (volume, flow, etc.).

The available commands to switch these PID pressure sets depend on the driver execution:

Fieldbus	Driver	Commands
NP	Standard and Standard with /X option	1 on-off input on main connector allow to switch the 2 PID parameters set (apply 0 VDC to select SET1 pressure PID and 24 VDC to select SET2)
	/S and /SX options	2 on-off inputs on main connector allow to switch the 4 PID parameters set (SET1.. SET4 - see the table for PID set selection)
BC, BP EH, EW EI, EP	All versions	real-time fieldbus communication can switch between the 4 PID parameters set (SET1 - SET4 - see driver manuals)

	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

22.12 Power Limitation (1)

A limit to the maximum pump hydraulic power can be software set into the driver in order to limit the pump power consumption to the coupled electrical motor. When the actual hydraulic power **p**x**Q** (pressure transducer feedback · flow reference value) reaches the set power limit, the driver automatically reduces the pump flow regulation.

The higher is the pressure feedback, the lower is the pumps regulated flow:

$$\text{Regulated Flow} = \text{Min} \left(\frac{\text{Set power Limit [kW]}}{\text{Pressure Feedback [bar]}} \cdot \frac{1}{\text{Flow Full Scale [l/min]}} ; \text{Flow Reference} \right)$$

The hydraulic power limitation, disabled as default, can be enabled via E-SW-SETUP programming software or via fieldbus communication, if available.
Standard and standard with /X option allow also to enable and disable this function during the machine cycle, using the D_IN on-off input available on the main connector (see 22.10).

(1) The sections 22.11 and 22.12 are a brief description of the settings and features of digital drivers with alternated p/Q control. For a detailed descriptions of available settings, wirings and installation procedures, please refer to the user manual included in the E-SW-SETUP programming software:
**E-MAN-RI-PES** - user manual for **PES-S** digital drivers

23.1 Main connector signals - 12 pin Ⓐ **Standard** and **Standard** with **/X** option - for **PES** and **PERS**

PIN	Standard	/X	TECHNICAL SPECIFICATIONS	NOTES
1	**V+**		Power supply 24 V$_{DC}$	Input - power supply
2	**V0**		Power supply 0 V$_{DC}$	Gnd - power supply
3	**FAULT**		Fault (0 V$_{DC}$) or normal working (24 V$_{DC}$), 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 V$_{DC}$ / ±20 mA maximum range Defaults are 0 ÷ 10 V$_{DC}$ for standard and 4 ÷ 20 mA for /I option	Input - analog signal **Software selectable**
6	**Q_MONITOR**		Flow monitor output signal: ±10 V$_{DC}$ / ±20 mA maximum range Defaults are 0 ÷ 10 V$_{DC}$ 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 V$_{DC}$ / ±20 mA maximum range Defaults are 0 ÷ 10 V$_{DC}$ for standard and 4 ÷ 20 mA for /I option	Input - analog signal **Software selectable**
8	**P_MONITOR**		Pressure monitor output signal: ±10 V$_{DC}$ / ±20 mA maximum range Defaults are 0 ÷ 10 V$_{DC}$ 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), pump enable (24 V$_{DC}$) / disable (0 V$_{DC}$) or multiple pressure PID selection. Referred to V0	Input - on/off signal
10	**TR+**		Remote pressure transducer input signal: ±10 V$_{DC}$ / ±20 mA maximum range Defaults are 0 ÷ 10 V$_{DC}$ 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

Remote pressure transducer connections - only for **Standard**
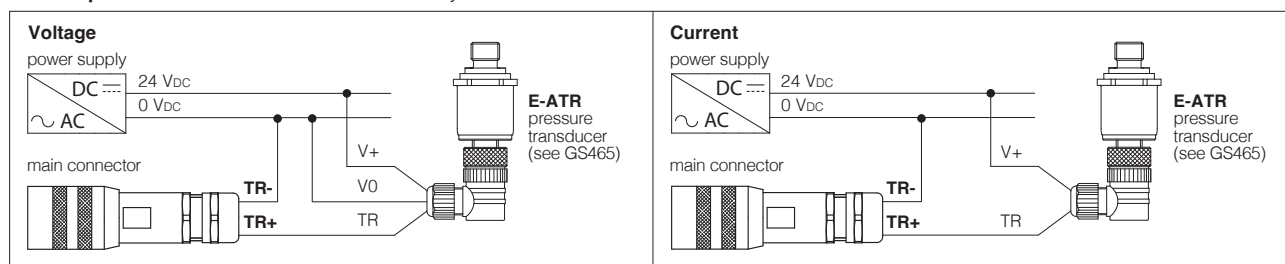
23.2 Main connector signals - 12 pin Ⓐ **/S** and **/SX** option - for **PES** and **PERS**

PIN	/S and /SX — NP	/S and /SX — Fieldbus	TECHNICAL SPECIFICATIONS	NOTES
1	**V+**		Power supply 24 V$_{DC}$	Input - power supply
2	**V0**		Power supply 0 V$_{DC}$	Gnd - power supply
3	**ENABLE** referred to: V0	VL0	Enable (24 V$_{DC}$) or disable (0 V$_{DC}$) the pump	Input - on/off signal
4	**Q_INPUT+**		Flow reference input signal: ±10 V$_{DC}$ / ±20 mA maximum range Defaults are 0 ÷ 10 V$_{DC}$ 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 V$_{DC}$ / ±20 mA maximum range Defaults are 0 ÷ 10 V$_{DC}$ for standard and 4 ÷ 20 mA for /I option	Output - analog signal **Software selectable**
7	**P_INPUT+**		Pressure reference input signal: ±10 V$_{DC}$ / ±20 mA maximum range Defaults are 0 ÷ 10 V$_{DC}$ 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 V$_{DC}$ / ±20 mA maximum range Defaults are 0 ÷ 10 V$_{DC}$ 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 V$_{DC}$ 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 V$_{DC}$ for driver's logic and communication	Gnd - power supply
11	**FAULT** referred to: V0	VL0	Fault (0 V$_{DC}$) or normal working (24 V$_{DC}$)	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

23.3 Communications connectors - for PES and PERS Ⓑ - Ⓒ

Ⓑ	USB connector - M12 - 5 pin	always present
PIN	**SIGNAL**	**TECHNICAL SPECIFICATION** (1)
1	**+5V_USB**	Power supply
2	**ID**	Identification
3	**GND_USB**	Signal zero data line
4	**D-**	Data line -
5	**D+**	Data line +

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

Ⓒ1 Ⓒ2	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**	

Ⓒ1 Ⓒ2	EH, EW, EI, EP 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**	

(1) Shield connection on connector's housing is recommended

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

23.4 Remote pressure transducer connector - M12 - 5 pin - for PES and PERS with for /S option Ⓓ1

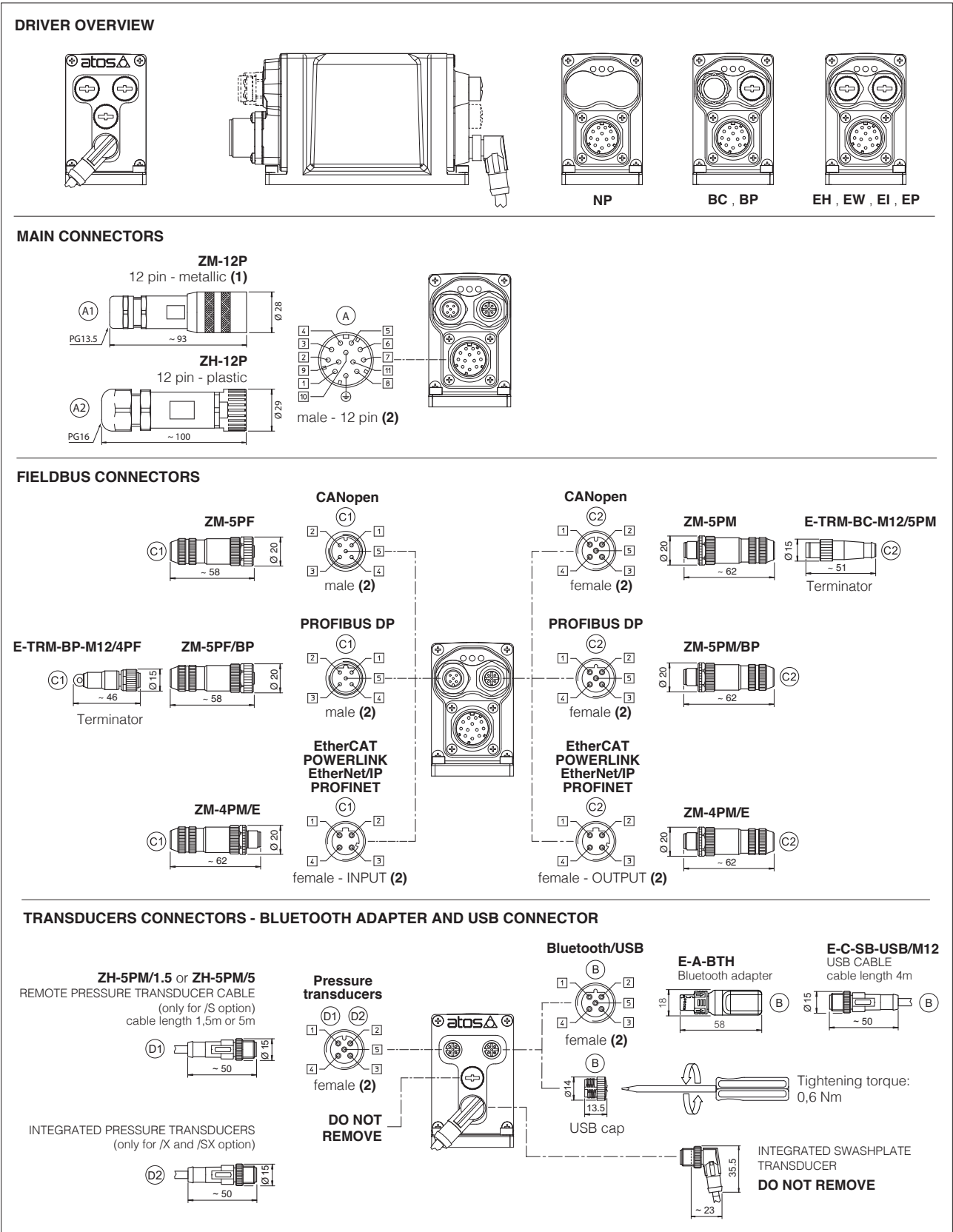| PIN	SIGNAL	TECHNICAL SPECIFICATION	NOTES	Voltage	Current
1	**VF +24V**	Power supply +24Vdc	Output - power supply	Connect	Connect
2	**TR1**	Signal transducer: ±10 Vdc / ±20 mA maximum range	Input - analog signal **Software selectable**	Connect	Connect
3	**AGND**	Common gnd for transducer power and signals	Common gnd	Connect	/
4	**NC**	Not connect		/	/
5	**NC**	Not connect		/	/

Remote pressure transducer connection - example
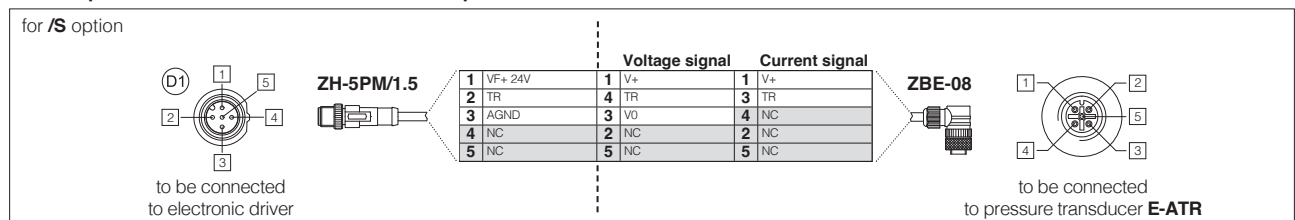
Note: pin layout referred to connector view

23.5 Solenoid connection - for CZ and LQZ

PIN	SIGNAL	TECHNICAL SPECIFICATION
1	**COIL**	Power supply
2	**COIL**	Power supply
3	**GND**	Ground

Connector code 666
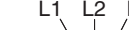
23.6 PES and PERS connections layout

DRIVER OVERVIEW

NP   BC , BP   EH , EW , EI , EP

MAIN CONNECTORS

ZM-12P
12 pin - metallic **(1)**

A1
PG13.5   ~ 93   Ø 28

A

ZH-12P
12 pin - plastic

A2
PG16   ~ 100   Ø 29

male - 12 pin **(2)**

4		5
3		6
2	A	7
9		11
1		8
10		

FIELDBUS CONNECTORS

ZM-5PF
C1   Ø 20   ~ 58

CANopen
C1
male **(2)**

CANopen
C2
female **(2)**

ZM-5PM
Ø 20   ~ 62

E-TRM-BC-M12/5PM
Ø 15   ~ 51   C2
Terminator

E-TRM-BP-M12/4PF
C1   Ø 15   ~ 46
Terminator

ZM-5PF/BP
Ø 20   ~ 58

PROFIBUS DP
C1
male **(2)**

PROFIBUS DP
C2
female **(2)**

ZM-5PM/BP
Ø 20   ~ 62   C2

ZM-4PM/E
C1   Ø 20   ~ 62

**EtherCAT
POWERLINK
EtherNet/IP
PROFINET**
C1
female - INPUT **(2)**

**EtherCAT
POWERLINK
EtherNet/IP
PROFINET**
C2
female - OUTPUT **(2)**

ZM-4PM/E
Ø 20   ~ 62   C2

TRANSDUCERS CONNECTORS - BLUETOOTH ADAPTER AND USB CONNECTOR

ZH-5PM/1.5 or **ZH-5PM/5**
REMOTE PRESSURE TRANSDUCER CABLE
(only for /S option)
cable length 1,5m or 5m

D1   Ø 15   ~ 50

Pressure transducers
D1 D2
female **(2)**

DO NOT REMOVE

Bluetooth/USB
B
female **(2)**

E-A-BTH
Bluetooth adapter
18   58   B

E-C-SB-USB/M12
USB CABLE
cable length 4m
Ø 15   ~ 50   B

B
Ø 14   13.5
USB cap

Tightening torque:
0,6 Nm

INTEGRATED PRESSURE TRANSDUCERS
(only for /X and /SX option)

D2   Ø 15   ~ 50

INTEGRATED SWASHPLATE
TRANSDUCER
DO NOT REMOVE
35,5   ~ 23

(1) Use of metallic connectors is strongly recommended in order to fulfill EMC requirements   **(2)** Pin layout always referred to driver's view

23.7 Diagnostic LEDs Ⓛ

Three leds show driver operative conditions for immediate basic diagnostics. Please refer to the driver user manual for detailed information.

| FIELDBUS ⟍ LEDS	NP Not Present	BC CANopen	BP PROFIBUS DP	EH EtherCAT	EW POWERLINK	EI EtherNet/IP	EP PROFINET	L1 L2 L3
L1	VALVE STATUS			LINK/ACT				
L2	NETWORK STATUS			NETWORK STATUS				
L3	SOLENOID STATUS			LINK/ACT				

24 IN / OUT FIELDBUS COMMUNICATION CONNECTORS

Two fieldbus communication connectors are always available for digital driver executions BC, BP, EH, EW, EI, EP.
This features allows considerable technical advantages in terms of installation simplicity, wirings reduction and
also avoid the usage expensive T-connectors.
For BC and BP executions the fieldbus connectors have an internal pass-through connection and can be used
like end point of the fieldbus network, using an external terminator (see tech table **AS800**).
For EH, EW, EI and EP execution the external terminators are not required: each connector is internally terminated.

BC and BP pass-through connection
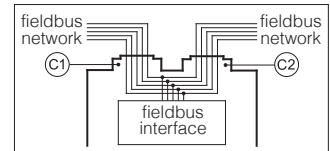
25 CONNECTORS CHARACTERISTICS - to be ordered separately

25.1 Main connectors

CONNECTOR TYPE	POWER SUPPLY AND SIGNALS	POWER SUPPLY AND SIGNALS
CODE	(A1) **ZM-12P**	(A2) **ZH-12P**
Type	12pin female straight circular	12pin female straight circular
Standard	DIN 43651	DIN 43651
Material	Metallic	Plastic reinforced with fiber glass
Cable gland	PG13,5	PG16
Recommended cable	LiYCY 12 x 0,75 mm² max 20 m (logic and power supply)	LiYCY 10 x 0,14mm² max 40 m (logic) LiYY 3 x 1mm² max 40 m (power supply)
Conductor size	0,5 mm² to 1,5 mm² - available for 12 wires	0,14 mm² to 0,5 mm² - available for 9 wires 0,5 mm² to 1,5 mm² - available for 3 wires
Connection type	to crimp	to crimp
Protection (EN 60529)	IP 67	IP 67

25.2 Fieldbus communication connectors

CONNECTOR TYPE	BC CANopen (1)		BP PROFIBUS DP (1)		EH EtherCAT, EW POWERLINK, EI EtherNet/IP, EP PROFINET (2)
CODE	(C1) **ZM-5PF**	(C2) **ZM-5PM**	(C1) **ZM-5PF/BP**	(C2) **ZM-5PM/BP**	(C1) (C2) **ZM-4PM/E**
Type	5 pin female straight circular	5 pin male straight circular	5 pin female straight circular	5 pin male straight circular	4 pin male straight circular
Standard	M12 coding A – IEC 61076-2-101		M12 coding B – IEC 61076-2-101		M12 coding D – IEC 61076-2-101
Material	Metallic		Metallic		Metallic
Cable gland	Pressure nut - cable diameter 6÷8 mm		Pressure nut - cable diameter 6÷8 mm		Pressure nut - cable diameter 4÷8 mm
Cable	CANbus Standard (DR 303-1)		PROFIBUS DP Standard		Ethernet standard CAT-5
Connection type	screw terminal		screw terminal		terminal block
Protection (EN 60529)	IP67		IP 67		IP 67

**(1)** E-TRM-** terminators can be ordered separately, see tech table **AS800**   **(2)** Internally terminated

25.3 Remote pressure transducer connectors

| CONNECTOR TYPE	PRESSURE TRANSDUCER	
CODE	(D1) **ZH-5PM/1.5**	(D1) **ZH-5PM/5**
Type	5 pin male straight circular	
Standard	M12 coding A – IEC 61076-2-101	
Material	Plastic	
Cable gland	Connector moulded on cables	
	1,5 m length	5 m length
Cable	5 x 0,25 mm²	
Connection type	molded cable	
Protection (EN 60529)	IP 67	

26 DIRECTION OF ROTATION

version D
clockwise rotation
viewed at the shaft end
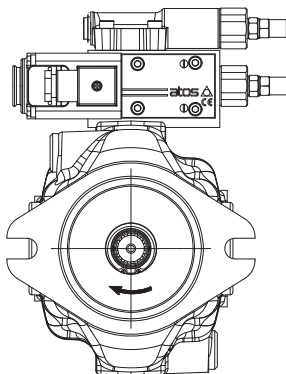
Pumps with clockwise rotation (**D**)
have the IN and OUT as shown in all
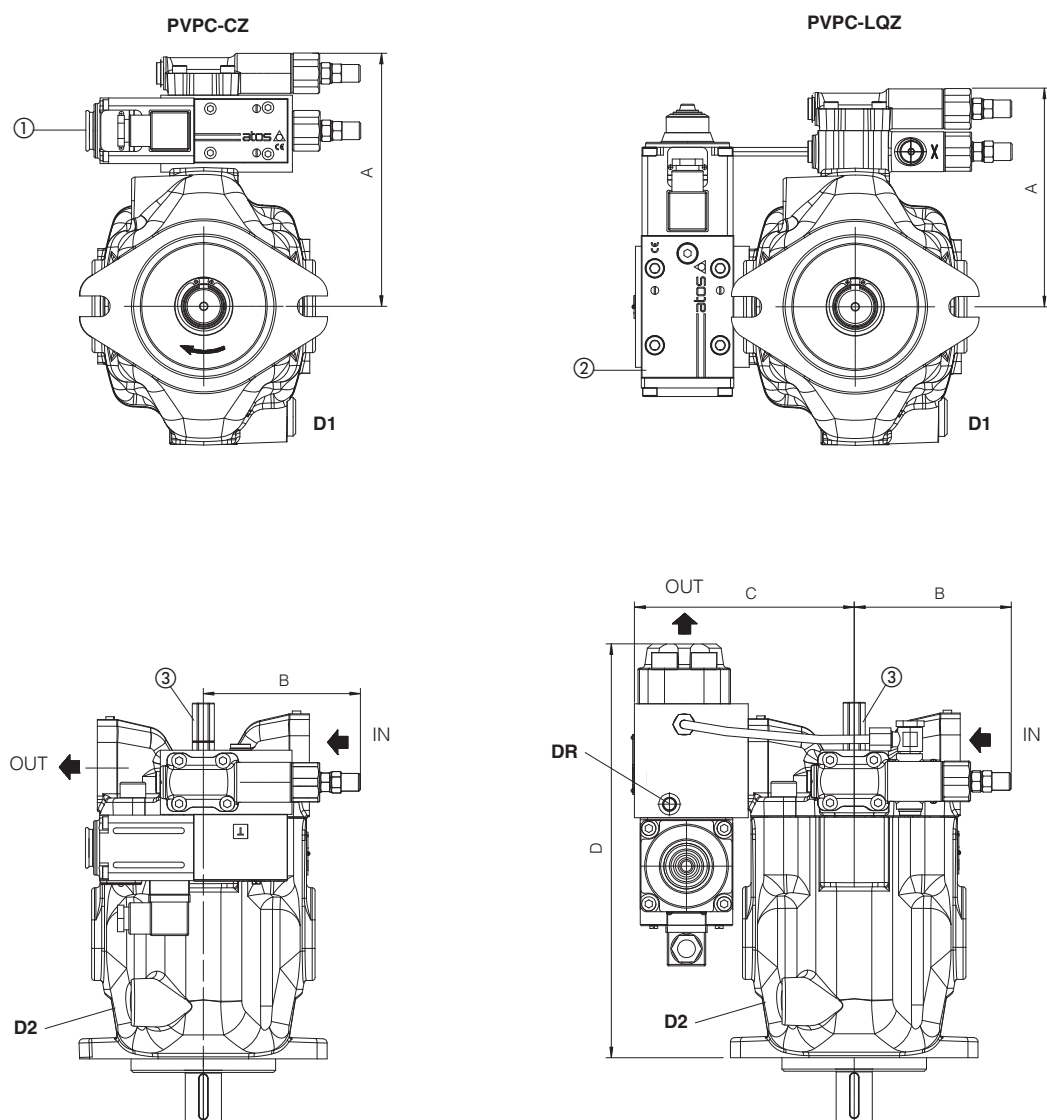representation of catalogue

version S
counterclockwise rotation
viewed at the shaft end
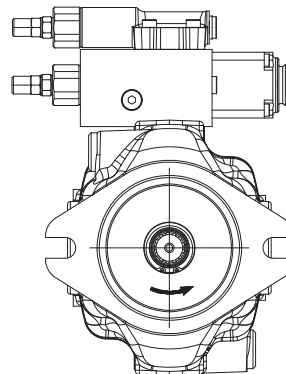
Pumps with counterclockwise rotation (**S**)
have the IN and OUT inverted and
consequently the position of the
electrohydraulic proportional controls

27.1 Dimension of PVPC size 3, 4, 5 - versions CZ, LQZ

PVPC-CZ

PVPC-LQZ

① = Proportional pressure control valve

② = Proportional flow control valve

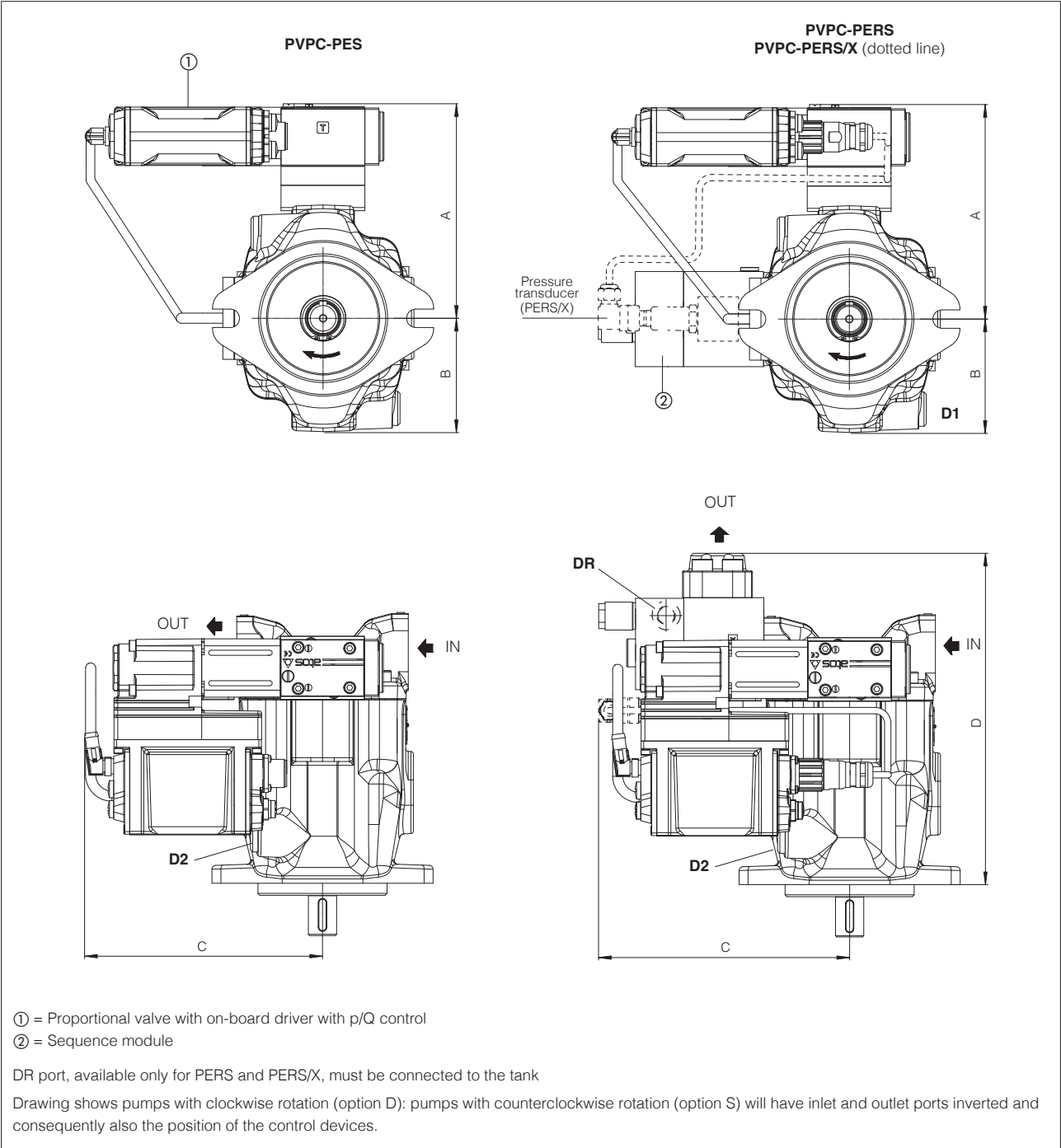③ = Regulation screw for max displacement. Adjustable range 50% to 100% of max displacement (not available for versions PES, PERS and PERS/X). In case of through shaft the regulation screw is not always available, please contact our technical office.

DR port, available only for LQZ, must be connected to the tank

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	DR	Mass (kg)
PVPC-*-3029	CZ	168	111	-	-	Flange SAE 3000 1 1/4"	Flange SAE 6000 3/4"	1/2" BSPP	-	22
	LQZ	144	111	132	257				3/8" G	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				3/8" G	33,6
PVPC-*-5073 PVPC-*-5090	CZ	190	111	-	-	Flange SAE 3000 2"	Flange SAE 6000 1 1/4"	3/4" BSPP	-	36,9
	LQZ	166	111	163	328				3/4" G	44

PVPC-PES

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

① = Proportional valve with on-board driver with p/Q control

② = Sequence module

DR port, available only for PERS and PERS/X, must be connected to the tank

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	DR	Mass (kg)
PVPC-*-3029	PES	170	103,5	190	-	Flange SAE 3000 1 1/4"	Flange SAE 6000 3/4"	1/2" BSPP	-	21,6
	PERS	170	103,5	200	262,5				1/4" G	26
	PERS/X	190	103,5	200	262,5				1/4" G	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				1/4" G	33,7
	PERS/X	178	103,5	220	299				1/4" G	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				3/4" G	46,7
	PERS/X	190	103,5	230	337				3/4" G	47,1

27.3 Dimension of PVPC size 6 - versions PES, PERS, PERS/X
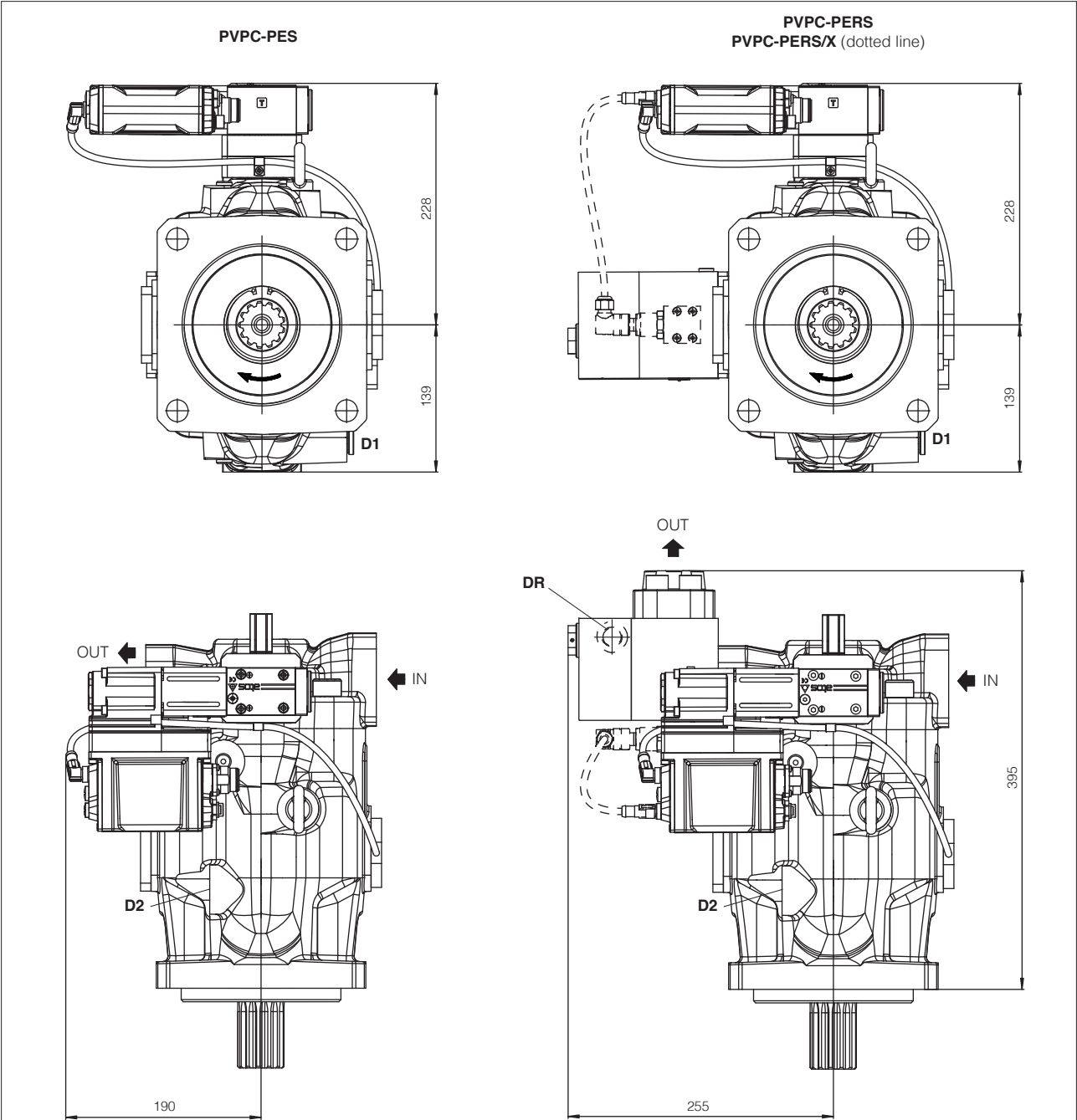
PVPC-PES	PVPC-PERS / PVPC-PERS/X (dotted line)

① = Proportional valve with on-board driver with p/Q control

② = Sequence module

DR port, available only for PERS and PERS/X, must be connected to the tank

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	IN	OUT	D1, D2	DR	Mass (kg)
PVPC-*-6140 PVPC-*-6160	PES	Flange SAE 3000 2 1/2"	Flange SAE 6000 1 1/4"	1 1/16"-12UNF	-	72,7
	PERS				3/4" G	82,8
	PERS/X				3/4" G	83,2

28 RELATED DOCUMENTATION

A900	Operating and maintenance information for pumps	**G030**	E-BM-AS digital driver
AS800	Programming tools	**GS050**	E-BM-AES digital driver
FS001	Basics for digital electrohydraulics	**GS510**	Fieldbus
FS500	Digital proportional valves with p/Q control	**K800**	Electric and electronic connectors
FS900	Operating and maintenance information for proportional valves	**P005**	Mounting surfaces for electrohydraulic valves
G010	E-MI-AC analog driver	**E-MAN-RI-PES**	PES user manual
G020	E-MI-AS-IR digital driver		