

Hydraulika proporcjonalna

Proportional electrohydraulics



Basics for proportional electrohydraulics

1 WHAT IS PROPORTIONAL ELECTROHYDRAULICS?

Electrohydraulic proportional controls modulate hydraulic parameters according to the electronic reference signals. They are the ideal interface between hydraulic and electronic systems and are used in open or in closed-loop controls, see section 3, to achieve the fast, smooth and accurate motions required by today's modern machines and plants.

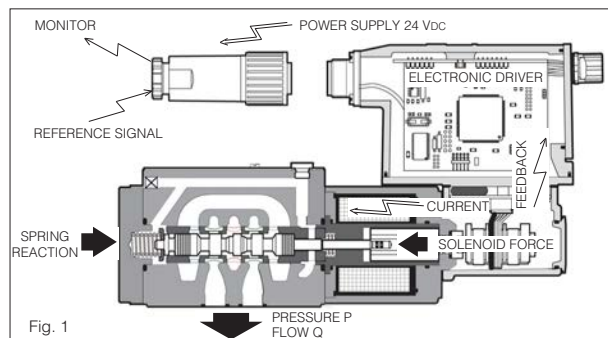
The electrohydraulic system is a section of the overall automation architecture unit where information, controls, alarms can be transmitted in a "transparent" way to the centralized electronic control unit and viceversa also via standard fieldbus, see tab. F002 for "Basics for digital electrohydraulics".

Proportional electrohydraulics provides the following advantages in comparison with the electromechanical systems; intrinsic overload protection, automatic force adaption, fast operating response, self lubrication of the system, simple stepless variation in speed, energy storage capability, high power density, forces and torques, long service life and high reliability.

2 WHAT IS A PROPORTIONAL VALVE?

The core of electrohydraulic controls is the proportional valve that regulates a pressure P or a flow Q according to the reference input signal (normally $\pm 10 V_{DC}$) supplied by the machine CNC. Particularly the proportional valve must be operated by an electronic driver (see tab. G001) which regulates a proper electrical current supplied to the valve's solenoid according to the reference signal. The solenoid converts the electrical current into a mechanical force acting the spool against a return spring: rising of the current produces a corresponding increasing in the output force and consequent compression of the return spring, thus the movement of the spool. The proportional valves can be single stage or piloted, with or without pressure/position transducer. Proportional valves with transducer provide better regulation accuracy. In pilot operated executions the proportional pilot valve regulates flow and pressure acting on the main operated stage.

When electrical failure occurs, return springs restore the neutral position according to valve configuration, to ensure a fail-safe operation, i.e. to ensure that in case of absence of reference signal or, generally, in case of electric system breakdown, the system configuration does not cause damages. Fail-safe can be realized directly by the proportional valve (fail-safe operation intrinsic in valve configuration) or it can be realized by consequential operation of a group of valves.



3 CONTROL LOOPS

Today industrial machines are multi-axis machines, more and more electrohydraulically controlled by proportional devices. The axis motion can be operated in "open loop" or in "closed loop" control, depending to the accuracy level required in the application. In many applications the motion cycles do not require extreme accuracy, so they are performed in open loop, while each time the application requires the positioning of an actuator, a closed loop control must be provided.

OPEN LOOP MOTION CONTROL

Axis control is provided through the supply of a reference input signal to the driver of the proportional valve.

There is no feedback of the valve's regulated hydraulic parameter.

The accuracy of the open loop controls is strictly dependent of the good quality of the hydraulic system and particularly of the proportional valve and of the relevant driver.

CLOSED LOOP MOTION CONTROL

Axis control is provided through the supply of an input reference signal to a closed loop axis controller which receive the feedback signal from the actuator transducer. The controller compares the two signals and the resulting error is then processed to the proportional valve, in order to align its regulation to the PID control loop requirements.

The accuracy of the closed loop controls is much better respect to the open loop ones and it is less influenced by the external environmental disturbances, thanks to the presence of the feedback.

Anyway the best is the overall quality of the hydraulic system, the best is the accuracy of the axis control.

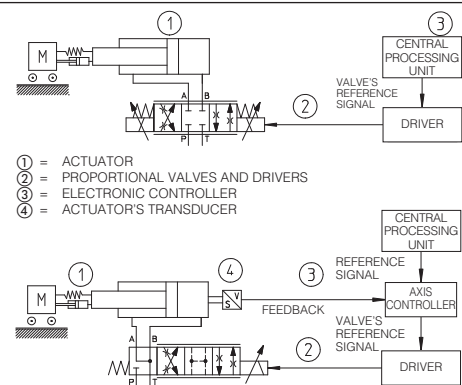


Fig 2: Electrohydraulic axes: a basic block diagrams

4 PROPORTIONAL VALVES AND DRIVERS

Atos valves may be spool type or cartridge execution and can be grouped in three different functional families:

- **pressure control valves: relief valves and reducing valves** regulate the hydraulic system pressure proportionally to the reference input signal;
- **4-way directional control valves:** direct and modulate the flow to an actuator proportionally to the reference input signal. These valves can be used in open or closed loop control system to determine the direction, speed and acceleration of actuators;
- **flow control valves:** 2 or 3-way, pressure compensated, to modulate the flow independently to the user loads.

Atos proportional valves are equipped with **ZO** and **ZOR**, efficient solenoids (30 W and 40 W) respectively designed for direct-acting valves of ISO 4401 size 06 and 10 and they are assembled in different options as follows:

ZO(R)-A: without integral transducer, open loop;

ZO(R)-AE, AES: as ZO-A plus integral electronic driver, analog or digital;

ZO(R)-T, -L: with integral LVDT single/double position transducer, closed loop, featuring high static and dynamic performances;

ZO(R)-TE, -LE, -LES: as ZO-T, -L plus integral electronic driver, analog or digital

In the new generation of -AE, -TE, -LE valves, the electronic driver is integral to the proportional valves and it is factory preset to ensure fine functionality plus valve-to-valve interchangeability and to simplify installation wiring and system set-up. Electronics are housed and resin encapsulated in a metal box to IP67, ensuring antivibration, antishock and weather-proof features; coils are fully plastic encapsulated.

For detailed information on Electronic drivers, see tab. G001

5 TYPICAL ELECTROHYDRAULIC TERMS

Repeatability: The maximum difference in the valve's hydraulic regulation repeating the same input reference signal. Repeatability is measured in percentage of the maximum value of the regulated hydraulic parameter.

Overlap: Percentage of spool stroke, starting from the central position, in which the valve remain closed.

Fail safe: spool's safety hydraulic configuration in absence of electrical power supply

Linear spool: provides linear correspondence between valves regulation and reference input signal

Progressive spool: provides progressive regulation for finest low flow control

Differential spool: as progressive but with P-B = 50% of P-A

Leakage: The flow passing through port P to tank port T with the valve spool in central position. It is directly connected with the quality of the valve's mechanical execution.

Reference input signal: The electric signal sent from machine CNC to the valve electronic driver to obtain the required regulation value.

Driving current: The current sent from the electronic driver to the valve's solenoid.

Bias current: Static offset added to the reference input signal required to compensate positive overlap spools.

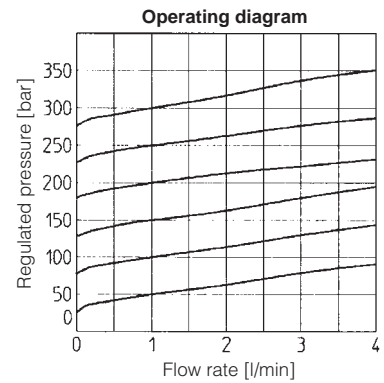
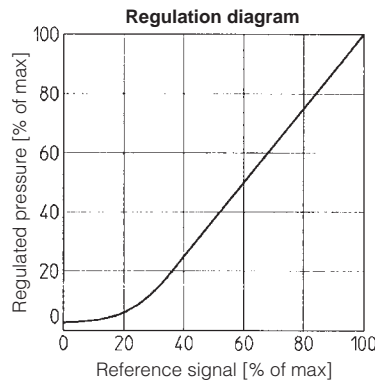
Dither: The pulse frequency of the driver regulation used to minimize the valve hysteresis.

Regulation scale: Setting of the valve regulation with the max reference signal.

Ramp time: Time (in sec.) required to smoothly operate the valve in front of a step reference input signal.

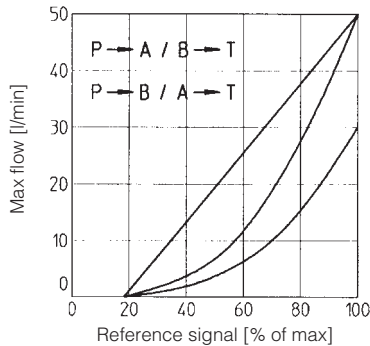
6 TYPICAL DIAGRAMS OF PROPORTIONAL CONTROLS

6.1 PRESSURE CONTROL VALVES

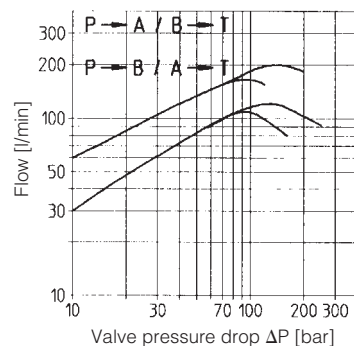


6.2 DIRECTIONAL AND FLOW CONTROL VALVES

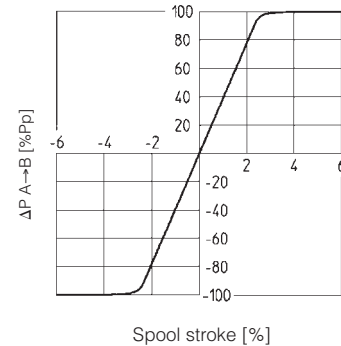
Regulation diagram at characteristic Δp



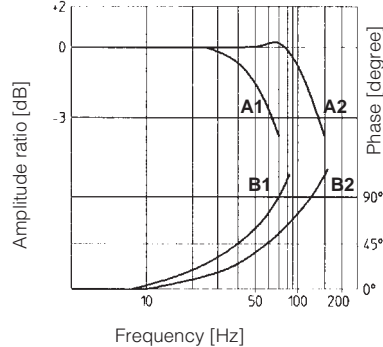
Regulation diagram at max reference signal



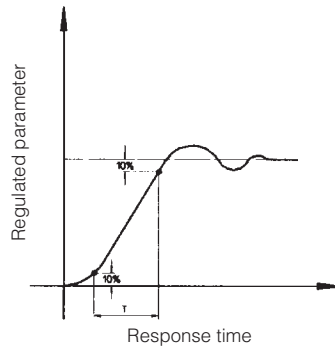
Pressure gain diagram



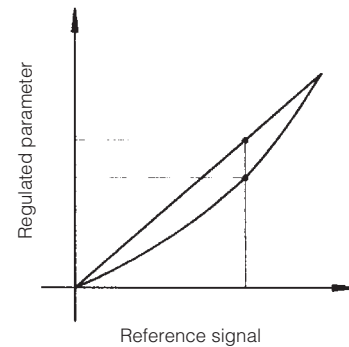
Bode diagram



Response time - step input



Hysteresis



Basics for digital electrohydraulics

1 DIGITAL TECHNOLOGY FOR PROPORTIONAL VALVES

Modern world is driven by digital electronics: computers, automation systems, cars and missiles, telecommunications and advanced network are all based on digital technology... ..thanks to its typical benefits in comparison with analog: fast and powerful data processing, easy programmability, high immunity to electromagnetic noise, process parameters and data storage.

In electrohydraulics, digital electronics gives important advantages:

- better performances of electrohydraulic components: hysteresis, response time, linearity;
- numerical software setting of hydraulic parameters (scale, bias, ramp, compensation of non-linearities) for full repeatability and easy data storage
- diagnostic (fault, monitor) and computer assisted maintenance of machines and systems;
- direct interfacing to field-bus networks.

Atos, leader in pioneering proportional electrohydraulics, is active from many years on digital electrohydraulics including: simulation models of valves and systems, research and testing of new DSP microcontrolles, R&D of new solutions.

New digital electrohydraulics with on board electronics enable new functionalities within the conventional control architectures and represent the fundamental premise to realize new compact machines with high technological contents.

The digital electronics integrate several logic and control functions (distributed intelligence) and make it feasible and inexpensive the introduction in the hydraulic system of the most modern fieldbus communication networks.

Atos digital driver's range replicate the analogue one:

- **E-RI-AES** for valves without transducer
- **E-RI-TES/LES** for valves with single/double LVDT transducer
- **E-RI-TERS** for valves with integral pressure transducer
- **E-RI-AERS** for valves predisposed for connection of remote pressure transducer

2 COMMUNICATION INTERFACES

The communication interface is the access port through which the valve receives commands and/or setting parameters and it returns information to the fieldbus master.

Atos digital proportional valves are available with 3 optional communication interfaces:

- basic **-PS**: serial programming RS232 interface.
The main feature of this basic version is the full interchangeability with the corresponding analog executions, in fact the reference and the monitor signals are analog, whereas the serial interface allows to manage the diagnostics and to set the best configuration of the valve for the application's requirements.
 - option **-BC**: CANopen (CanOpen DS408 v1.5 protocol)
 - option **-BP**: Profibus DP (Fluid Power Technology protocol).
- The valves with option -BC and -BP can be connected to the fieldbus network and thus digitally operated by the machine control unit.

The functional parameters can be set via fieldbus using the standard communication protocol implemented by Atos, or alternatively using the PC graphic software E-SW-BC or E-SW-BP with the relevant USB interface KIT (see tab. G500). For start-up or maintenance operations, the valves with -BC or -BP interfaces can be operated with analogue signals via the 7 (or 12) pins power supply connector.

3 DIGITAL SETTINGS AND DIAGNOSTICS by ATOS PROGRAMMING SOFTWARE

A large number of the functional parameters of the valve can be easily set trough the communication interface, using the Atos E-SW programming software, as:

- the bias and scale
- the ramps, corresponding to the transition time from 0% to 100% of the valve's regulation
- the linearization of the hydraulic regulation
- dither frequency

Many other regulations, including the valve functional diagnostic are available, see tab. G001 for additional information.

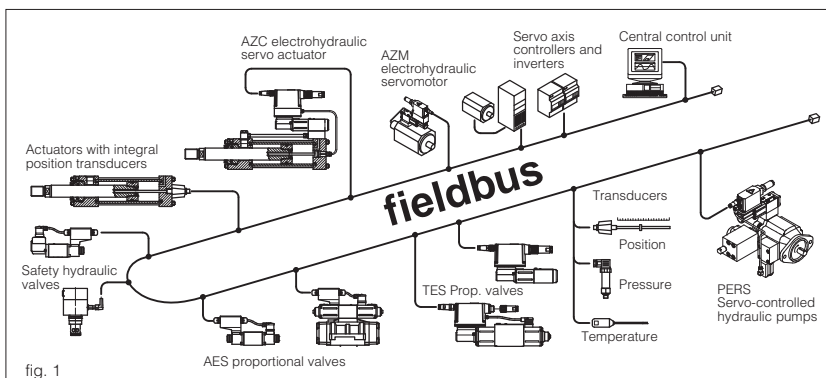
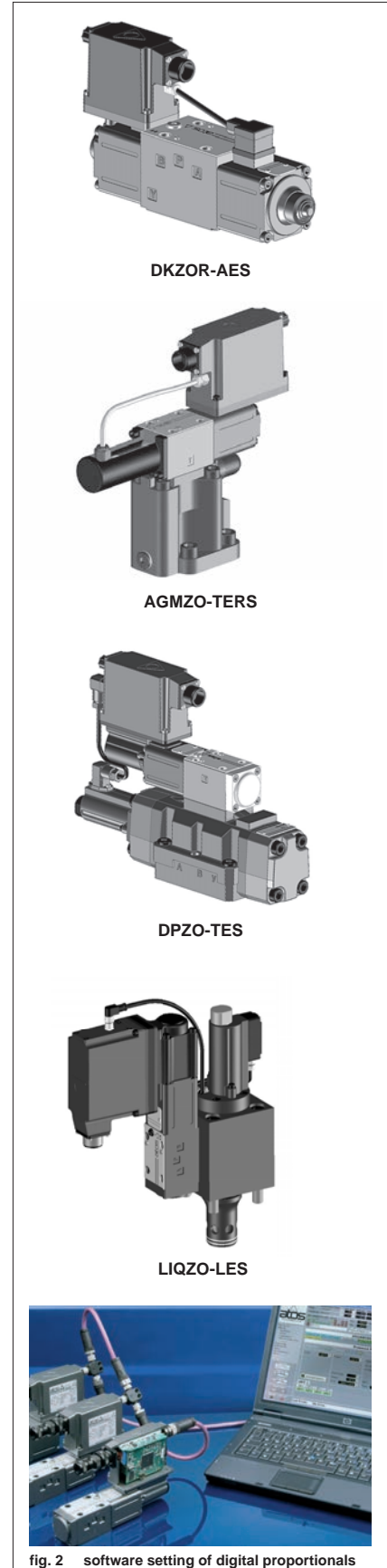


fig. 2 software setting of digital proportionals

4 PRESSURE-FORCE/FLOW COMBINED CONTROLS FOR PROPORTIONAL DIRECTIONAL VALVES, see tab. G212

In most of the machines, the typical movement of a single actuator requires direction, speed and sometime force regulations, normally performed by different valves.

The integral digital drivers with /SP, /SF, /SL options add the pressure or force closed loop to the spool position control of standard proportional directional valves. A single proportional valve with /S* option allows to manage complex machine operations requiring high performance combined regulations (typical application: injection cycle or mould motion in plastic machinery).

The closed loop pressure or force control requires the installation in the system of one/two remote pressure transducers or a load cell, to be connected to the valve digital driver. The option /SP performs the closed loop pressure control in one direction by using 1 remote pressure transducer (see fig.3). The other two options perform the closed loop force control by means of 2 remote pressure transducers (option /SF, see fig.4) or load cell (option /SL, see fig.5).

The pressure (force) and flow levels are regulated with independent command signals. The selection from pressure-force to flow control and vice versa is self performed by the digital driver through dedicated algorithm.

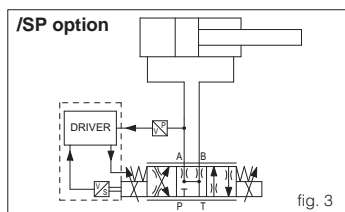


fig. 3

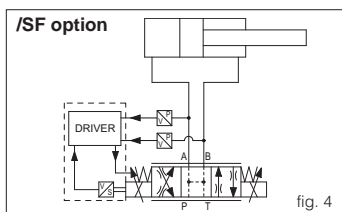


fig. 4

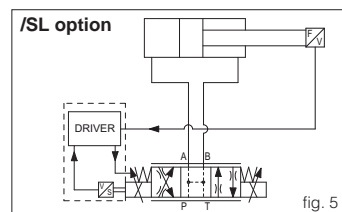


fig. 5

Position transducer

Pressure transducer

Load cell

5 COMBINED P/Q CONTROLS FOR VARIABLE PISTON PUMPS, see tab. A170 and G215

The digital driver E-RI-PES for PVPC-PE(R)S variable displacement axial piston pumps (see fig. 6), integrates the digital combined closed loop pressure and flow control with the electronic max power limitation. The -PERS pump directly controls the system pressure and the speed of machine actuators.

A multiple set of PID parameters can be real time selected during the axis motion via the 12 pin connector (option /S) or through the -BC or -BP interfaces, to optimize the P/Q control performances.

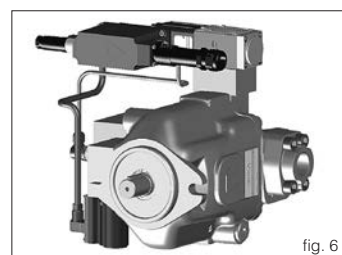


fig. 6

6 EX-PROOF INTEGRAL DIGITAL CONTROLS, see tab. F600

The ex-proof proportional valves with new ex-proof integral digital drivers provide consistent advantages as compact execution, simplified wiring and reduced risk of electromagnetic disturbances.

They allow to exploit all the performances provided by the standard digital electronics: software setting of the main functional parameters (bias, scale, ramps regulation, linearization of the hydraulic characteristic) and the possibility to integrate the valves into a fieldbus network, thanks to the optional -BC and -BP interfaces.

The drivers are ATEX certified and they are available for the full range of ex-proof proportional valves, open and closed loop.



fig. 7

7 DIGITAL SOLUTIONS FOR OPEN LOOP SERVOSYSTEMS, see tab. G120

The concept of distributed intelligence is applied in its easiest form to the drivers type E-RI-AEG.

This controller is a cycle generator for proportional directional valves without position transducer, which self-manages repetitive open loop "fast-slow speed" motion cycles, without auxiliary axis controller.

The cycle phases can be operated through up to five inductive proximity sensors to be interfaced to the driver (see fig.8) or by on-off command signals from the machine CNC.

For any of the cycle phases it is possible to set into the driver speed and ramps.

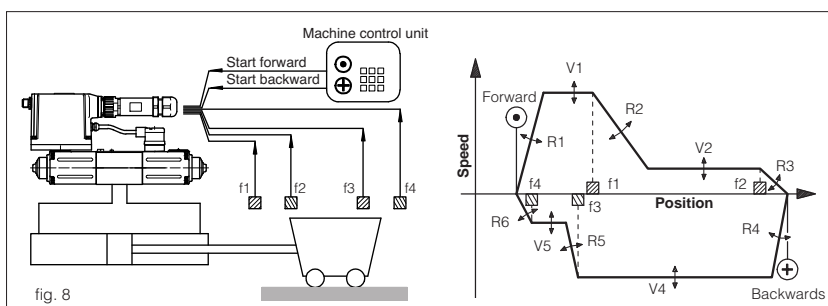


fig. 8

8 DIGITAL AXIS CONTROLLERS, see tab. G003

The digital axis controllers perform accurate closed loop position controls with additional speed or pressure/force regulations.

They are available in three executions with different characteristics to better comply the several applications requirements:

Z-RI-TEZ, integral to the proportional directional valve ①. It can be supplied pre-assembled with Atos servocylinder ② making a compact motion control unit called "servoactuator" (see fig.9)

Z-ME-KZ, Eurocard format, with extended electronic interfaces

Z-BM-HZ, DIN-rail mounting, high performance multiple axes controllers

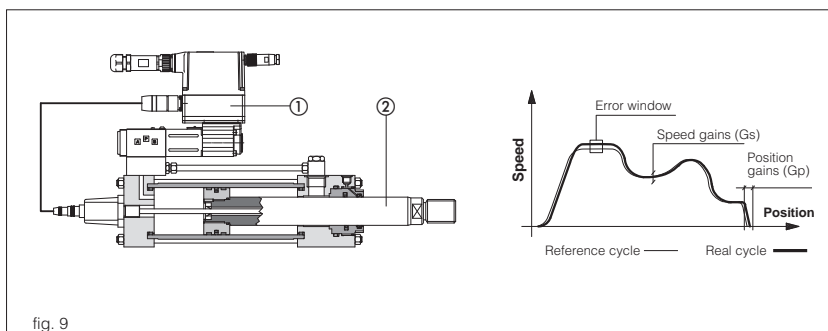
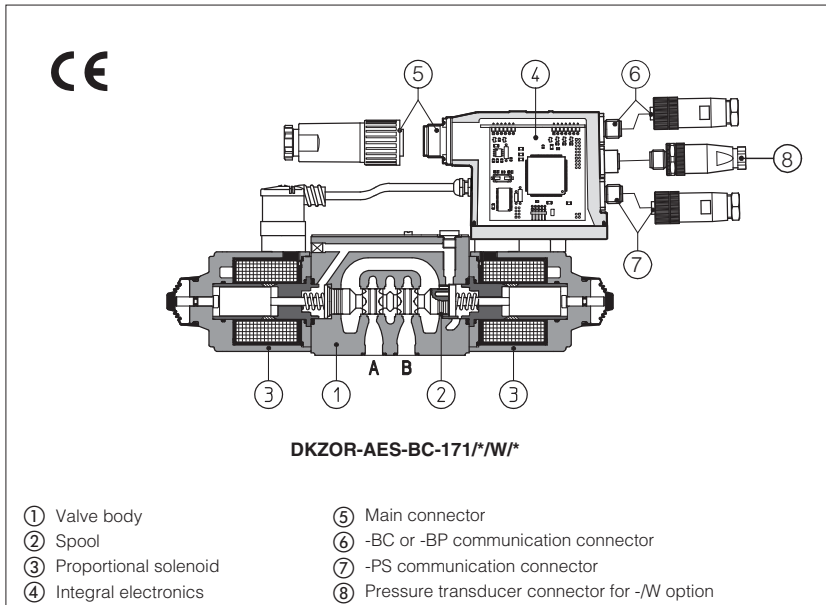


fig. 9

Proportional directional valves type DHZO-A* and DKZOR-A*

direct operated, without position transducer, ISO 4401 size 06 and 10



1 MODEL CODE

DHZO - AES - PS - 0 7 1 - S 5 / * / * ** / *

<p>DHZO = size 06 DKZOR = size 10</p> <p>A = without position transducer AE = as A plus integral electronics AES = as A plus integral digital electronics AEG = as AES plus internal reference generation (1) AEZ = as AES plus internal cycle generation (2)</p> <p>Communication interfaces (only for digital electronics) PS = Serial (3) BC = CANopen (only AES) BP = PROFIBUS DP (only AES)</p> <p>Valve size 0 = ISO 4401 size 06 1 = ISO 4401 size 10</p> <p>Configuration, see section 3 5 = external plus central position, spring centered 7 = 3 position, spring centered</p> <p>Spool overlapping in central position, see section 3 1 = P, A, B, T positive overlapping (20% of spool stroke) 3 = P positive overlapping; (20% of spool stroke) A, B, T, negative overlapping</p> <p>Spool type (regulating characteristics) L = linear; S = progressive; D = differential-progressive (as S, but with P-A= Q, P-B= Q/2)</p>	<p>Synthetic fluids WG = water-glycol PE = phosphate ester</p> <p>Series number</p> <p>Coils voltage (only for -A execution): see section 6: - = standard 12 V_{DC} coil 6 = with 6 V_{DC} coil 18 = with 18 V_{DC}</p> <p>Hydraulic options, see section 4: B = solenoid and integral electronics at side of port A Y = external drain</p> <p>Options for -A execution see section 4: MO = horizontal hand lever MV = vertical hand lever BMO = horizontal hand lever installed at side of port A BMV = vertical hand lever installed at side of port A N = manual micrometric adjustment NV = as N plus handwheel and graduated scale</p> <p>Electronics options for -AE execution see section 8: I = current reference input (4±20 mA) Q = enable signal</p> <p>Electronics options for -AES execution see section 10: Q = enable signal Z = double power supply, enable fault and monitor (12 pin connector) W = power limitation function (12 pin connector) see section 10.3</p> <p>Spool size: 14, 1, 3, 5 = see section 3</p>
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Notes:

- (1) For detailed description of AEG internal reference generation, see tab. G120
- (2) For detailed description of AEZ internal cycle generation, see tab. G120
- (3) Serial interface always present, also for -BC and -BP options

2 ELECTRONIC DRIVERS FOR DHZO-A*

Valve model	-A						-AE	-AES	-AEG	-AEZ
Drivers model	E-MI-AC-0*F	E-MI-AS-IR	E-BM-AC-0*F	E-BM-AS-PS	E-ME-AC-0*F	E-RP-AC-0*F	E-RI-AE	E-RI-AES	E-RI-AEG	E-RI-AEZ
Data sheet	G010	G020	G025	G030	G035	G100	G110	G115	G120	G120

Note: For power supply and communication connector see section 17 and 13

DHZO-A* and DKZOR-A* are proportional valves, direct operated without position transducer, which provide both directional and non-compensated flow control according to the electronic reference signal.

They operate in association with electronic drivers, see section 2, which supply the proportional valves with proper current to align valve regulation to the reference signal supplied to the electronic driver.

They are available in different executions:

- -A, without position transducer;
- -AE, -AES as -A plus analogue (AE) or digital (AES) integral electronics (4);
- -AEG, as AES plus internal reference generation selected by four on-off inputs (0÷24V_{DC}) available on the main connector (see tab. G120).
- -AEZ, as AES plus internal cycle generation for automatic control of actuator's motion cycle (see tab. G120).

The 4-way spool (2), sliding into a 5-chambers body (1), is directly operated by proportional solenoids (3).

The integral electronics (4) ensures factory presetting, fine functionality plus valve-to-valve interchangeability and simplified wiring and installation.

The electronic main connector (6) is fully interchangeable for -AE and -AES executions.

Standard 7 pin main connector is used for power supply, analog input reference and monitor signals.

12 pin connector is used for -AEG, -AEZ versions and for option /Z (AES).

Following communication interfaces (6), (7) are available for the digital -AES, -AEG and -AEZ executions:

- standard -PS, Serial communication interface for configuration, monitoring and firmware updating through Atos PC software - always present.
- optional -BC, CANopen interface (only for -AES)
- optional -BP, PROFIBUS DP interface (only for -AES)

The valves with -BC and -BP interfaces can be integrated into a fieldbus communication network and thus digitally operated by the machine control unit.

The coils are fully plastic encapsulated (insulation class H) and the valves have antivibration, antishock and weather-proof features.

Mounting surface: ISO 4401 sizes 06 and 10.

Max flow respectively up to 50 l/min and 105 l/min with valve differential pressure Δp = 30 bar, see table 3.

Max pressure = 350 bar for DHZO;
315 bar for DKZOR.

3 HYDRAULIC CHARACTERISTICS (based on mineral oil ISO VG 46 at 50 °C)

Hydraulic symbols	*71, *71/B	*73, *73/B	*51	*53	*51/B	*53/B	
Valve model	DHZO					DKZOR	
Spool overlapping	1, 3	1, 3	1, 3	1, 3	1, 3	1, 3	
Spool type and size	L14	L1	S2	S3, L3, D3	S5, L5, D5	S3, L3, D3	
Pressure limits [bar]	ports P, A, B = 350; T = 210 (250 with external drain /Y)					ports P, A, B = 315; T = 210 (250 /Y)	
Max flow (1) [l/min]							
at $\Delta p = 10$ bar (P-T)	1	4,5	8	17	28	45	
at $\Delta p = 30$ bar (P-T)	2	8	14	30	50	80	
at $\Delta p = 70$ bar (P-T)	3	12	21	45	74	120	
Response time (2) [ms]	< 30					< 40	
Hysteresis [%]	$\leq 5\%$					$\leq 5\%$	
Repeatability	$\pm 1\%$					$\pm 1\%$	

Notes:

- Above performance data refer to valves coupled with Atos electronic drivers, see section 2.
- The flow regulated by the directional proportional valves is not pressure compensated, thus it is affected by the load variations. To keep constant the regulated flow under different load conditions, modular pressure compensators are available (see tab. D150).

(1) For different Δp , the max flow is in accordance to the diagrams in sections 14.2 and 15.2

4 HYDRAULIC OPTIONS

4.1 Option /B Solenoid (for valve configuration *5*), and integral electronics at side of port A. For hydraulic configuration vs. reference signal, see section 14.1 and 15.1

4.2 Option /Y External drain advisable when the valve is used in double flow path, see section 14.5 and 15.5. Option /Y is mandatory if the pressure in port T exceeds 160 bar.

5 GENERAL NOTES

DHZO and DKZOR proportional valves 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 valve (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).

6 OPTIONS FOR -A EXECUTION

6.1 Option /6 6 V_{DC} coil instead of standard 12 V_{DC}, to be used in case of power supply 12 V_{DC}

6.2 Option /18 18 V_{DC} coil instead of standard 12 V_{DC}, to be used with electronic drivers not supplied by Atos

6.3 Auxiliary hand lever

this option is available only for DHZO-A with spool type S3, S5, D3, D5, L3, L5.

It allows to operate the valve in absence of electrical power supply. For detailed description of DHZO-A with hand lever option see table E138

- **Option /MO** horizontal hand lever
- **Option /MV** vertical hand lever
- **Option /BMO** horizontal hand lever installed at side of port A
- **Option /BMV** vertical hand lever installed at side of port A

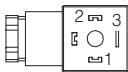
The following options allow to operate the valve in absence of electrical power supply by means of a micrometric screw replacing the standard solenoid manual override, see table K500

6.4 Option /N manual micrometric adjustment

6.5 Option /NV as /N plus handwheel and graduated scale

7 CONNECTIONS FOR -A EXECUTION

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



8 ANALOG INTEGRAL DRIVERS -AE - OPTIONS

Standard driver execution provides on the 7 pin main connector:

Power supply - 24V_{DC} must be appropriately stabilized or rectified and filtered; a 2.5 A safety fuse is required in series to the driver power supply. Apply at least a 10000 μ F/40 V capacitance to single phase rectifiers or a 4700 μ F/40 V capacitance to three phase rectifiers

Reference input signal - analog differential input with ± 10 V_{DC} nominal range (pin D,E), proportional to desired coil current

Monitor output signal - analog output signal proportional to the actual valve's coil current (1V monitor = 1A coil current)

Following options are available to adapt standard execution to special application requirements:

8.1 Option /I

It provides the 4÷20 mA current reference signal instead of the standard ± 10 V_{DC}. Monitor output signal is still the standard ± 10 V_{DC}

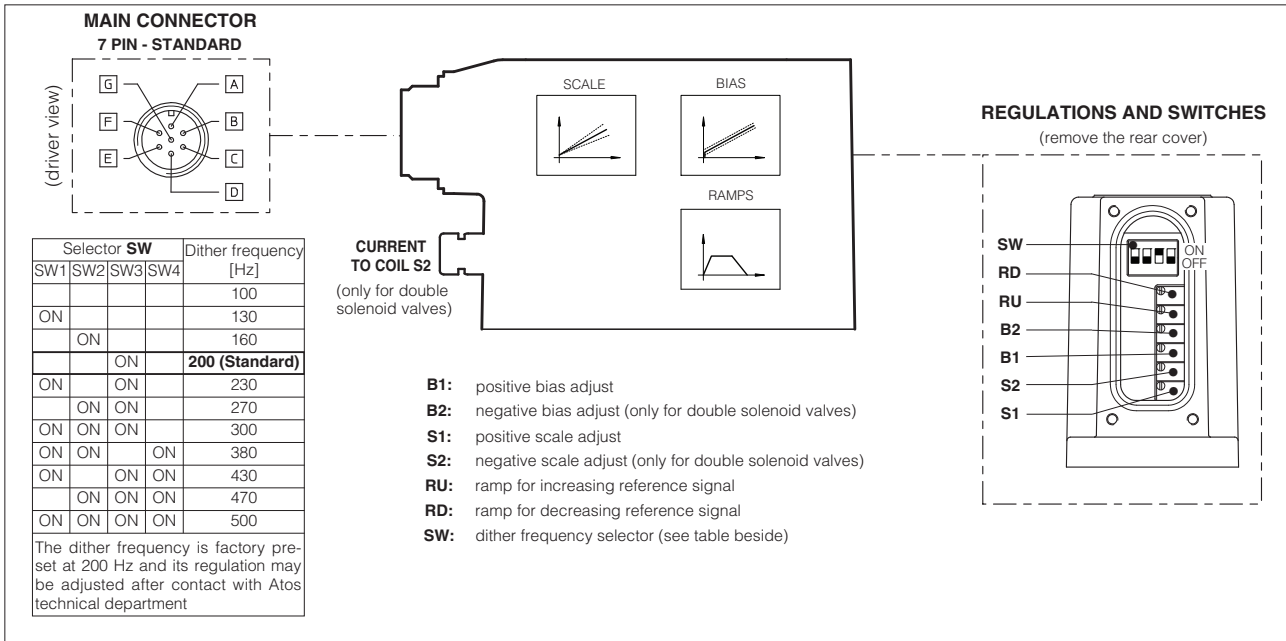
It is normally used in case of long distance between the machine control unit and the valve or where the reference signal can be affected by electrical noise; the valve functioning is disabled in case of reference signal cable breakage.

8.2 Option /Q

It provides the possibility to enable or disable the valve functioning without cutting the power supply (the valve functioning is disabled but the driver current output stage is still active). To enable the driver supply a 24V_{DC} on the enable input signal.

8.2 Possible combined option: /IQ

9 ANALOG INTEGRAL DRIVERS -AE - MAIN FUNCTIONS AND ELECTRONIC CONNECTIONS



9.1 ELECTRONIC CONNECTIONS - 7 PIN MAIN CONNECTORS

PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
A	V+	Power supply 24 Vdc for solenoid power stage and driver logic	Input - power supply
B	V0	Power supply 0 Vdc for solenoid power stage and driver logic	Gnd - power supply
C ⁽¹⁾	AGND	Ground - signal zero for MONITOR signal	Gnd - analog signal
	ENABLE	Enable (24 Vdc) or disable (0 Vdc) the driver (for /Q option)	Input - on/off signal
D	INPUT+	Reference analog differential input: ±10 Vdc maximum range (4 ÷ 20 mA for /I option) Default setting for single solenoid valves: 0÷+10 Vdc Default setting for double solenoid valves: ±10 Vdc	Input - analog signal
E	INPUT -		
F	MONITOR	Monitor analog output: ±5 Vdc maximum range; 1 V = 1 A	Output - analog signal
G	EARTH	Internally connected to the driver housing	

Note: (1) with /Q option ENABLE signal replaces AGND on pin C; MONITOR signal is referred to pin B.

A minimum time of 60ms to 160ms have been 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

10 DIGITAL INTEGRAL DRIVERS -AES - OPTIONS

Standard driver execution provides on the 7 pin main connector:

- Power supply** - 24Vdc must be appropriately stabilized or rectified and filtered; a 2,5 A safety fuse is required in series to each driver power supply. Apply at least a 10000 µF/40 V capacitance to single phase rectifiers or a 4700 µF/40 V capacitance to three phase rectifiers.
- Reference input signal** - analog differential input with ±10Vdc nominal range (pin D,E), proportional to desired coil current (4÷20 mA with cable break detection, ±10 mA, ±20 mA or 0÷20 mA software selectable)
- Monitor output signal** - analog output signal proportional to the actual valve's coil current (1V monitor = 1A coil current)

Following options are available to adapt standard execution to special application requirements:

10.1 Option /Q

To enable the driver, supply 24Vdc on pin C referred to pin B: when the enable signal is set to zero the valve status is software selectable, by factory default the valve functioning is disabled (zero current to the solenoid) but the driver current output stage is still active. For the complete list of selectable status, see tab. G115.

10.2 Option /Z

It provides, on the 12 pin main connector, the following additional features:

Logic power supply

Separated 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. This condition allows to realize safety systems in compliance with European Norms EN13849-1 (ex EN954-1).

Enable Input Signal

To enable the driver, supply 24Vdc on pin 3 referred to pin 2: when the enable signal is set to zero the valve status is software selectable, by factory default the valve functioning is disabled (zero current to the solenoid) but the driver current output stage is still active. For the complete list of selectable status, see tab. G115.

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, etc.). Fault presence corresponds to 0 Vdc, normal working corresponds to 24Vdc (pin 11 referred to pin 2): Fault status is not affected by the Enable input signal

10.3 Option /W - only for valves coupled with pressure compensator type HC-011 or KC-011 (see tab. D150).

It provides, on the 12 pin main connector, the above option /Z features plus the hydraulic power limitation function.

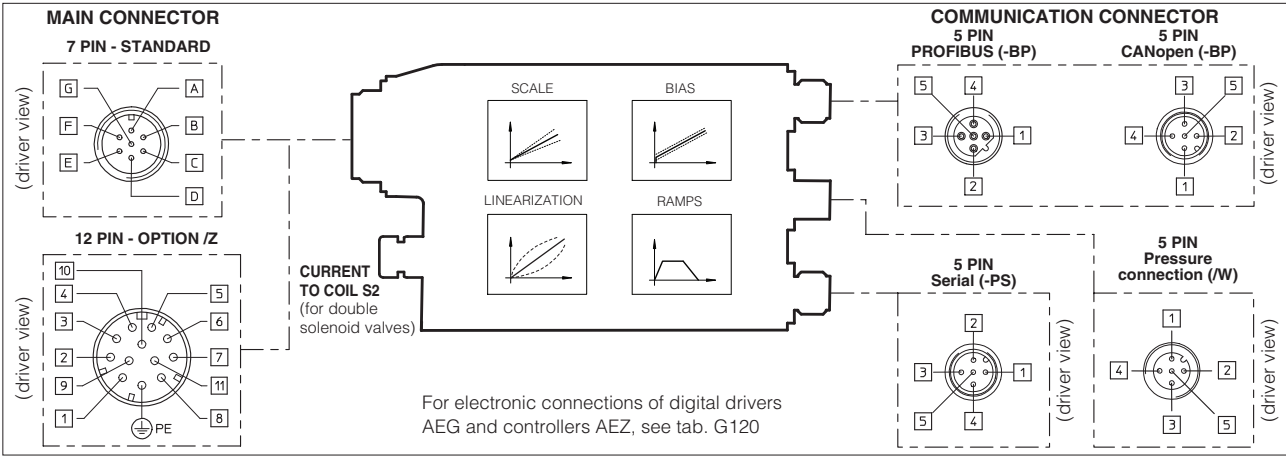
The driver receives the flow reference signal by the analog external input INPUT+ and a pressure transducer remotely installed in the hydraulic system, has to be connected to the driver's analog input TR.

When the actual requested hydraulic power $p \times Q$ (TR x INPUT+) reaches the max power limit ($p1 \times Q1$), internally set by software, the driver automatically reduces the flow regulation of the valve. The higher is the pressure feedback the lower is the valve's regulated flow:

$$\text{Flow regulation} = \text{Min} \left(\frac{\text{PowerLimit [sw setting]}}{\text{Transducer Pressure [TR]}} ; \text{Flow Reference [INPUT+]} \right)$$

For detailed information on hydraulic power limitation, see tab. G115

11 DIGITAL INTEGRAL DRIVERS -AES - MAIN FUNCTIONS AND ELECTRONIC CONNECTIONS



11.1 ELECTRONIC CONNECTIONS - 7 & 12 PIN MAIN CONNECTORS (-AES standard, /Q, /Z, /W options)

Standard 7pin	/Z, /W options 12pin	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
A	1	V+	Power supply 24 Vdc for solenoid power stage (and for driver logic on 7 pin connection)	Input - power supply
B	2	V0	Power supply 0 Vdc for solenoid power stage (and for driver logic on 7 pin connection)	Gnd - power supply
C (option /Q)	3	ENABLE	Enable (24 Vdc) or disable (0 Vdc) the driver	Input - on/off signal
D	4	INPUT+	Reference analog input: ±10 Vdc / ±20 mA maximum range software selectable	Input - analog signal
E	-	INPUT -	Default setting for single solenoid valves: 0÷+10 Vdc, differential input Default setting for double solenoid valves: ±10 Vdc, differential input /Z and /W options: common mode INPUT+ referred to AGND	
C	5	AGND	Ground - signal zero for MONITOR signal (INPUT+ signal only for /Z and /W options)	Gnd - analog signal
F	6	MONITOR	Monitor analog output: ±5 Vdc maximum range; Default setting 1V = 1A	Output - analog signal
-	7	NC	do not connect	
-	8	MONITOR 2	2nd monitor analog output: ±5 Vdc maximum range (only for /W option)	Output - analog signal
-	9	VL+	Power supply 24 Vdc for driver logic	Input - power supply
-	10	VL0	Power supply 0 Vdc for driver logic	Gnd - power supply
-	11	FAULT	Fault (0 Vdc) or normal working (24 Vdc)	Output - on/off signal
G	PE	EARTH	Internally connected to the driver housing	

Note: A minimum time of 270 to 340 ms have to 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.

11.2 ELECTRONIC CONNECTIONS - 5 PIN COMMUNICATION AND PRESSURE TRANSDUCER CONNECTORS

PIN	-PS Serial		-BC CANopen		-BP PROFIBUS DP		/W option	
	SIGNAL	TECHNICAL SPECIF.	SIGNAL	TECHNICAL SPECIF.	SIGNAL	TECHNICAL SPECIF.	SIGNAL	TECHNICAL SPECIF.
1	NC	do not connect	CAN_SHLD	Shield	+5V	for termination	VT	transducer power supply 24 Vdc
2	NC	do not connect	NC	do not connect	LINE-A	Bus line (high)	TR	transducer signal 0÷10 Vdc
3	RS_GND	Signal zero data line	CAN_GND	Signal zero data line	DGND	Data line and termination Signal zero	AGND	Signal zero for power supply and signal
4	RS_RX	Receiving data line	CAN_H	Bus line (high)	LINE-B	Bus line (low)	NC	do not connect
5	RS_TX	Transmitting data line	CAN_L	Bus line (low)	SHIELD	do not connect	NC	do not connect

12 SOFTWARE TOOLS

The driver configuration and parameters can be easily set with the Atos E-SW programming software, available in three different versions according to the driver's communication execution: E-SW-PS (Serial), E-SW-BC (CANopen) and E-SW-BP (PROFIBUS DP). Programming software E-SW-BC and E-SW-BP, for BC and BP driver's, can be also used to modify the valve's parameterization through the serial communication interface, without disconnecting the valve from the machine's bus line.

For a more detailed description of software interface, PC requirements, adapters, cables and terminators, please refer to technical table G500.

Programming software, must be ordered separately:

E-SW-* (mandatory - first supply) = Dvd including E-SW-* software installer and operator manuals; it allows the registration to Atos digital service
E-SW-*-N (optional - next supplies) = as above but not allowing the registration to Atos digital service

On first supply of the E-SW-* software, it is required to apply for the registration in the Atos download area: www.download.atos.com.

Once the registration is completed, the password will be sent by email.

The software remains active for 10 days from the installation date and then it stops until the user inputs his password.

With the password you can also download, in your personal area, the latest releases of the Atos software, manuals, drivers and configuration files.

13 MAIN CHARACTERISTICS OF PROPORTIONAL DIRECTIONAL VALVES

Assembly position	Any position					
Subplate surface finishing	Roughness index, $\sqrt{0.4}$ flatness ratio 0,01/100 (ISO 1101)					
Ambient temperature	-20°C ÷ +70°C for -A execution; -20°C ÷ +60°C for -AE, -AES, -AEG and -AEZ executions					
Fluid	Hydraulic oil as per DIN 51524 ... 535 for other fluids see section II					
Recommended viscosity	15 ÷ 100 mm ² /s at 40°C (ISO VG 15÷100)					
Fluid contamination class	ISO 18/15 achieved with in line filters of 10 µm and $\beta_{10} \geq 75$ (recommended)					
Fluid temperature	-20°C +60°C (standard and /WG seals) -20°C +80°C (/PE seals)					
Coil Voltage	DHZO-A*			DKZOR-A*		
	with 12 V _{dc} coil	with 6 V _{dc} coil	with 18 V _{dc} coil	with 12 V _{dc} coil	with 6 V _{dc} coil	with 18 V _{dc} coil
Coil resistance R at 20°C	3 ÷ 3,3 Ω	2 ÷ 2,2 Ω	13 ÷ 13,4 Ω	3,8 ÷ 4,1 Ω	2,2 ÷ 2,4 Ω	12 ÷ 12,5 Ω
Max. solenoid current	2,2 A	2,75 A	1 A	2,6 A	3,25 A	1,2 A
Max. power	30 Watt			35 Watt		
Protection degree (CEI EN-60529)	IP65 for -A execution; IP67 for -AE, -AES, -AEG and -AEZ executions					
Duty factor	Continuous rating (ED=100%)					

14 DIAGRAMS FOR DHZO (based on mineral oil ISO VG 46 at 50 °C)

14.1 Regulation diagrams

- 1 = linear spool L14
- 2 = linear spool L1
- 3 = progressive spool S2
- 4 = linear spool L3
- 5 = progressive spool S3, D3
- 6 = linear spool L5
- 7 = progressive spool S5, D5

Note:

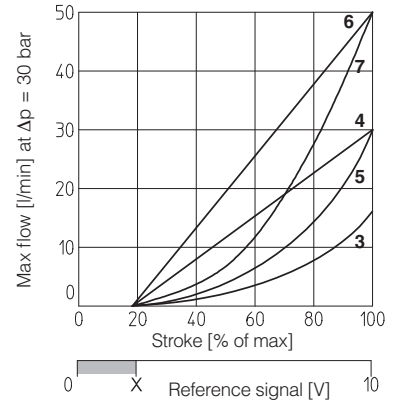
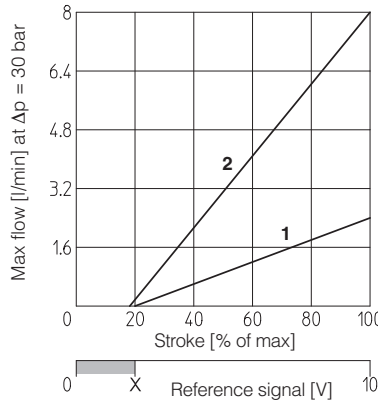
Hydraulic configuration vs reference signal for double solenoid valves (standard and option /B)

Reference signal $0 \div +10 \text{ V}$ } $P \rightarrow A / B \rightarrow T$
 $12 \div 20 \text{ mA}$ }

Reference signal $0 \div -10 \text{ V}$ } $P \rightarrow B / A \rightarrow T$
 $4 \div 12 \text{ mA}$ }

Hydraulic configuration vs reference signal for single solenoid valves:

Reference signal:
 $0 \div +10 \text{ V}$ } $P \rightarrow A / B \rightarrow T$ (standard)
 $4 \div 20 \text{ mA}$ } $P \rightarrow B / A \rightarrow T$ (option /B)

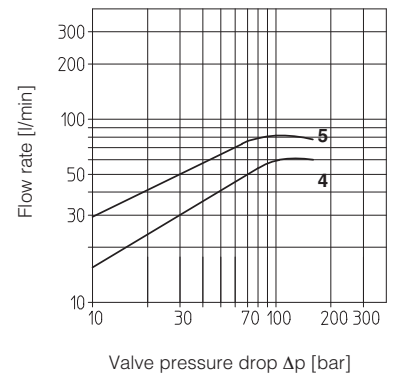
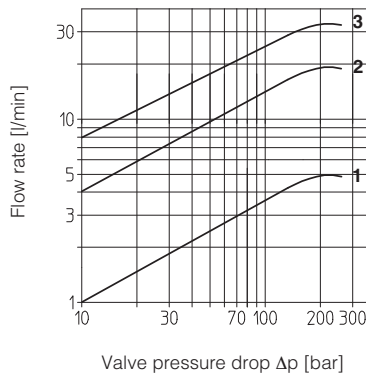


X = Threshold for bias activation depending to the valve type and amplifier type

14.2 Flow / Δp diagrams

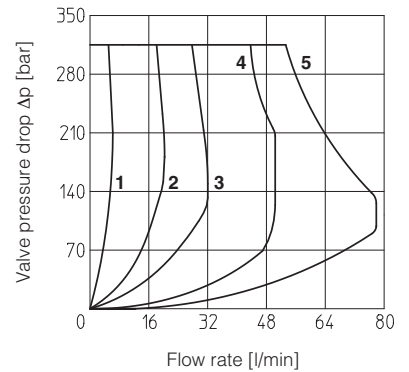
stated at 100% of valve stroke

- 1 = spool L14
- 2 = spool L1
- 3 = spool S2
- 4 = spool S3, L3, D3
- 5 = spool S5, L5, D5



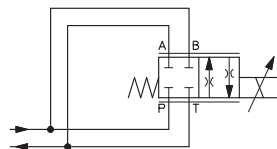
14.3 Operating limits

- 1 = spool L14
- 2 = spool L1
- 3 = spool S2
- 4 = spool L3, S3, D3
- 5 = spool L5, S5, D5



14.4 Operation as throttle valve

Single solenoid valves (DHZO*-051) can be used as simple throttle valves:
 $P_{max} = 250 \text{ bar}$ (option /Y advisable)



	SPOOL TYPE						
	L14	L1	S2	L3	S3	L5	S5
Max flow $\Delta p = 70 \text{ bar}$ [l/min]	6	20	40	80	100		

15 DIAGRAMS FOR DKZOR (based on mineral oil ISO VG 46 at 50 °C)

15.1 Regulation diagrams

- 1 = linear spool L3
- 2 = progressive spool S3, D3
- 3 = linear spool L5
- 4 = progressive spool S5, D5

Note:

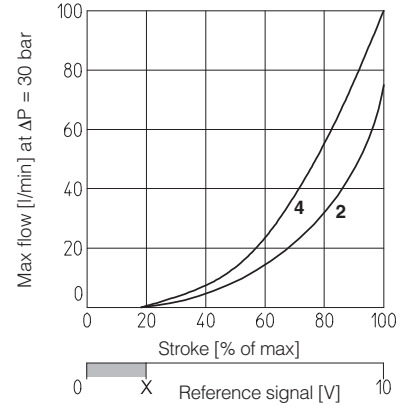
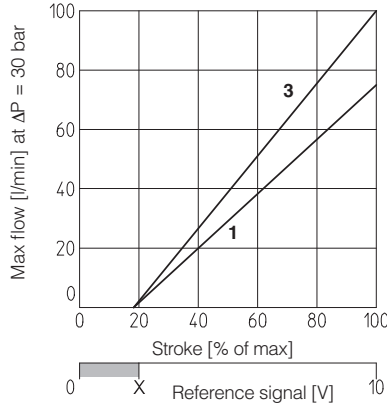
Hydraulic configuration vs reference signal for double solenoid valves (standard and option /B)

Reference signal $0 \div +10 \text{ V}$ } P → A / B → T
 $12 \div 20 \text{ mA}$ }

Reference signal $0 \div -10 \text{ V}$ } P → B / A → T
 $4 \div 12 \text{ mA}$ }

Hydraulic configuration vs reference signal for single solenoid valves:

Reference signal:
 $0 \div +10 \text{ V}$ } P → A / B → T (standard)
 $4 \div 20 \text{ mA}$ } P → B / A → T (option /B)

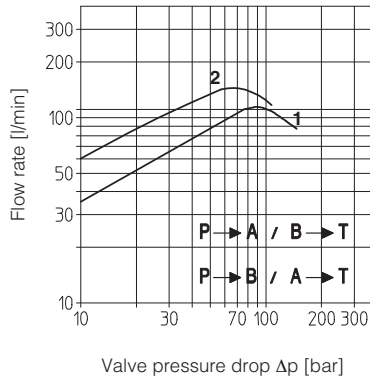


X = Threshold for bias activation depending to the valve type and amplifier type

15.2 Flow /Δp diagrams

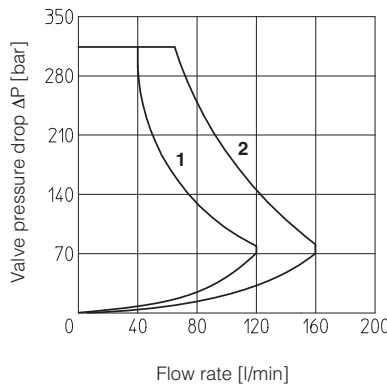
stated at 100% of valve stroke

- 1 = spool S3, L3, D3
- 2 = spool S5, L5, D5



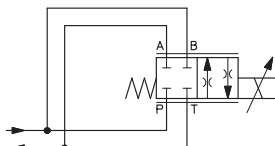
15.3 Operating limits

- 1 = spool L3, S3, D3
- 2 = spool L5, S5, D5



15.4 Operation as throttle valve

Single solenoid valves (DKZOR*-151) can be used as simple throttle valves: Pmax = 250 bar (option /Y advisable)



	SPOOL TYPE			
	L3	S3	L5	S5
Max flow Δp= 30 bar [l/min]	100		160	

16 INSTALLATION DIMENSIONS FOR DHZO [mm]

ISO 4401: 2005

Mounting surface: 4401-03-02-0-05 (see table P005)
 (for /Y version, surface 4401-03-03-0-05 without X port)

Fastening bolts: 4 socket head screws M5x50 class 12.9

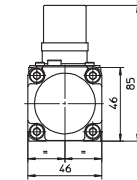
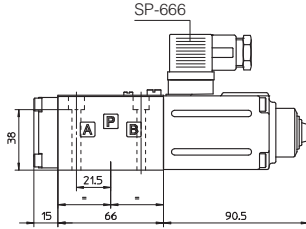
Tightening torque = 8 Nm

Seals: 4 OR 108; 1 OR 2025

Diameter of ports A, B, P, T: Ø 7,5 mm (max)

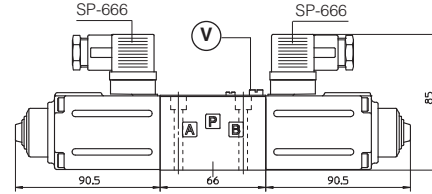
Diameter of port Y: Ø = 3,2 mm (only for /Y option)

DHZO-A-05



Mass: 1,9 kg

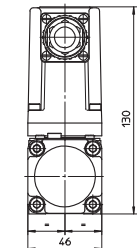
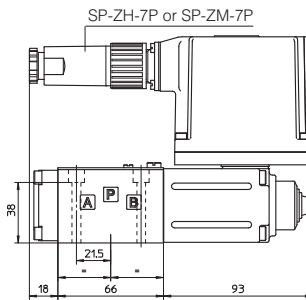
DHZO-A-07



Mass: 2,6 kg

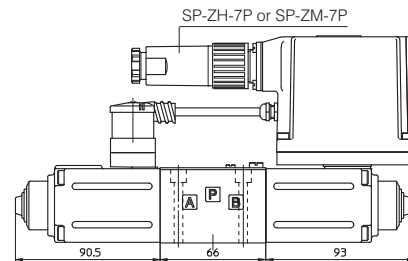
Note: for option /B the solenoid is at side of port A

DHZO-AE-05



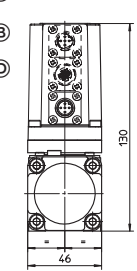
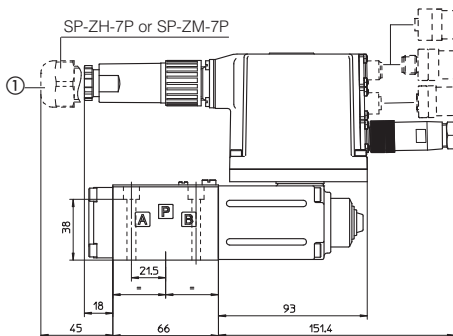
Mass: 2,3 kg

DHZO-AE-07



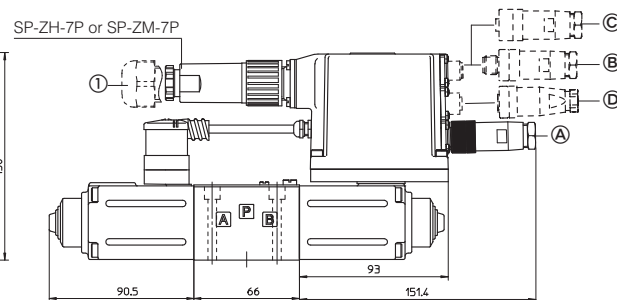
Mass: 3,1 kg

DHZO-AES (-AEG, -AEZ) -05



Mass: 2,3 kg

DHZO-AES (-AEG, -AEZ) -07



Mass: 3,1 kg

- Ⓐ -PS communication interface, SP-ZH-5P connector
- Ⓑ -BP communication interface, SP-ZH-5P/BP connector
- Ⓒ -BC communication interface, SP-ZH-5P connector
- Ⓓ Pressure transducer interface (option /W), SP-ZH-5PM connector

① Dotted line = 12 poles connector SP-ZH-12P for -AES option /Z, -AEG, -AEZ

Note: for option /B the solenoid and the integral electronics are at side of port A

17 MODEL CODES OF POWER SUPPLY AND COMMUNICATION CONNECTORS (to be ordered separately)

VALVE VERSION	-A	-AE, -AES		-AES/Z -AEG -AEZ	-AES/W	-Serial (-PS) or CANopen (-BC)	PROFIBUS DP (-BP)
CONNECTOR CODE	SP-666	SP-ZH-7P	SP-ZM-7P	SP-ZH-12P	SP-ZH-5PM	SP-ZH-5P	SP-ZH-5P/BP
PROTECTION DEGREE	IP65	IP67	IP67	IP67	IP67	IP67	IP67
DATA SHEET	K500	G110, G115, G120, K500			G115, K500		

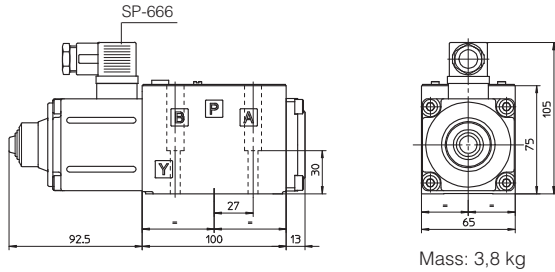
connectors supplied with the valve

18 INSTALLATION DIMENSIONS FOR DKZOR [mm]

ISO 4401: 2005

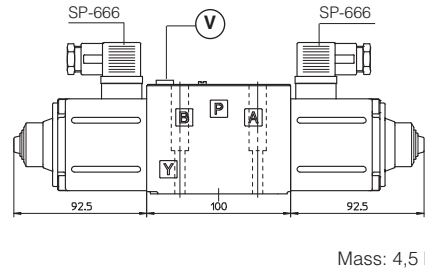
Mounting surface: 4401-05-04-0-05 (see table P005)
(for /Y version, surface 4401-05-05-0-05 without X port)
 Fastening bolts: 4 socket head screws M6x40 class 12.9
 Tightening torque = 15 Nm
 Seals: 5 OR 2050; 1 OR 108
 Diameter of ports A, B, P, T: \varnothing 11,2 mm (max)
 Diameter of port Y: \varnothing = 5 mm (only for /Y option)

DKZOR-A-15



Mass: 3,8 kg

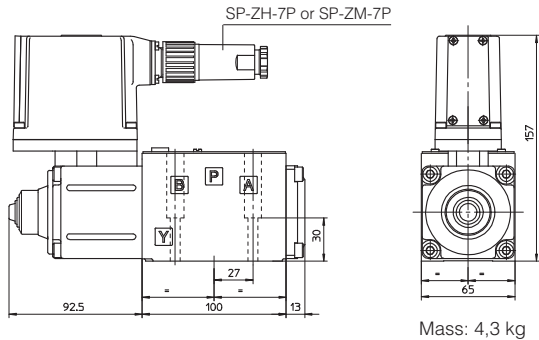
DKZOR-A-17



Mass: 4,5 kg

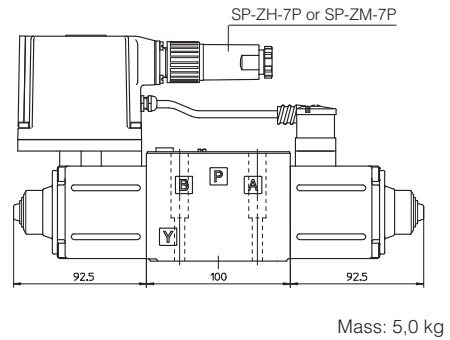
Note: for option /B the solenoid is at side of port A

DKZOR-AE-15



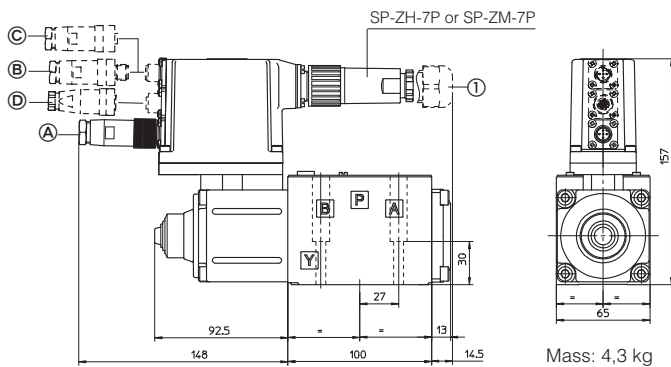
Mass: 4,3 kg

DKZOR-AE-17



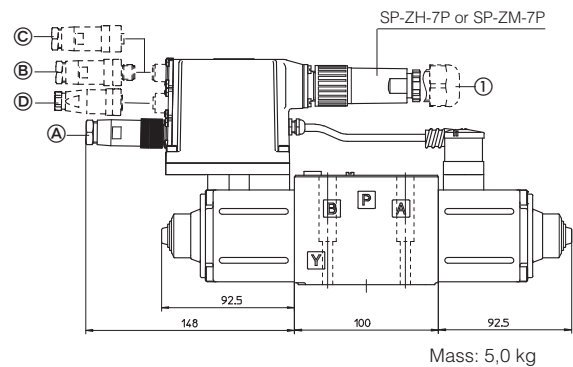
Mass: 5,0 kg

DKZOR-AES (-AEG, -AEZ) -15



Mass: 4,3 kg

DKZOR-AES (-AEG, -AEZ) -17



Mass: 5,0 kg

- Ⓐ -PS communication interface, SP-ZH-5P connector
- Ⓑ -BP communication interface, SP-ZH-5P/BP connector
- Ⓒ -BC communication interface, SP-ZH-5P connector
- Ⓓ Pressure transducer interface (option /W), SP-ZH-5PM connector

Ⓢ Dotted line = 12 poles connector SP-ZH-12P for AES option /Z, -AEG, -AEZ

Note: for option /B the solenoid, the position transducer and the integral electronics are at side of port A

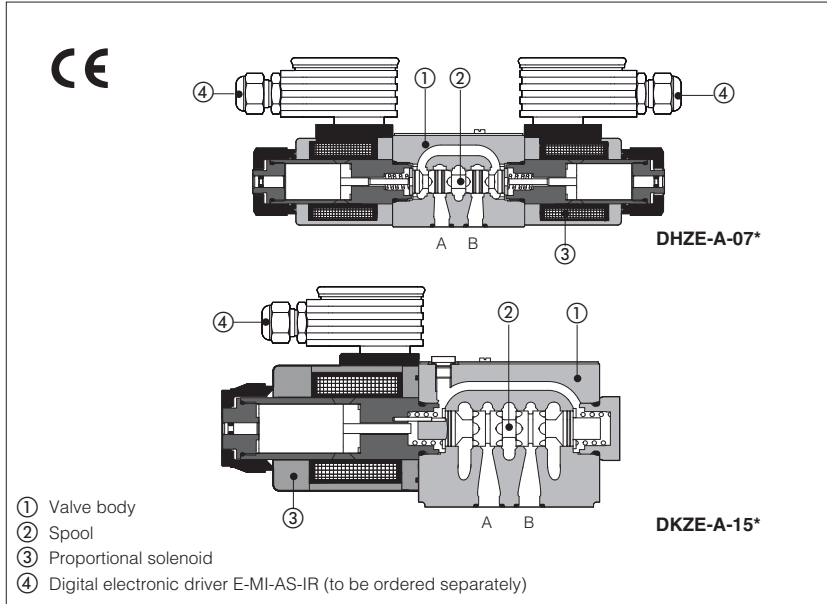
19 MODEL CODES OF POWER SUPPLY AND COMMUNICATION CONNECTORS (to be ordered separately)

VALVE VERSION	-A	-AE, -AES		-AES/Z -AEG -AEZ	-AES/W	-Serial (-PS) or CANopen (-BC)	PROFIBUS DP (-BP)
CONNECTOR CODE	SP-666	SP-ZH-7P	SP-ZM-7P	SP-ZH-12P	SP-ZH-5PM	SP-ZH-5P	SP-ZH-5P/BP
PROTECTION DEGREE	IP65	IP67	IP67	IP67	IP67	IP67	IP67
DATA SHEET	K500	G200, G210, G120, K500			G210		

connectors supplied with the valve

Proportional directional valves type DHZE-A and DKZE-A

direct operated, without position transducer, ISO 4401 size 06 and 10



DHZE-A and DKZE-A are open-loop direct operated proportional valves with threaded type proportional solenoids, providing both directional and non-compensated flow control.

They operate in association with electronic drivers, see section 2, which supply the proportional valves with proper current to align the valve regulation to the reference signal supplied to the electronic driver.

The spools are available with linear L, progressive S or differential D flow characteristics.

The valve body is 3 chambers type.

The solenoid coils are plastic encapsulated with insulation class H and they are available with different nominal resistances depending to the voltage supply (12 V_{DC} or 24 V_{DC}) and to the electronic driver type, see section 2 and 4.

Mounting surface:

ISO 4401 sizes 06 and 10.

Max flow with valve differential pressure $p = 30$ bar, see section 3

50 l/min for DHZE - 105 l/min for DKZE

**Max pressure = 350 bar for DHZE
315 bar for DKZE**

1 MODEL CODE

DHZE	-	A	-	0	7	1	-	S	5	/	*	/	*	**	/	*
<p>DHZE = size 06 DKZE = size 10</p>		<p>A = without position transducer</p>														
<p>Valve size 0 = ISO 4401 size 06 (DHZE) 1 = ISO 4401 size 10 (DKZE)</p>		<p>Seals material: omit for NBR (mineral oil & water glycol) PE = FPM</p> <p>Series number</p>														
<p>Configuration, see section 3 5 = external plus central position, spring centered 7 = 3 position, spring centered</p>		<p>Coil option (only for -A execution) see section 2 and 4: - = standard coil for 24V_{DC} Atos drivers 6 = optional coil for 12V_{DC} Atos drivers 18 = optional coil for 24V_{DC} low current drivers</p>														
<p>Spool overlapping in central position, see section 3 1 = P, A, B, T positive overlapping (20% of spool stroke) 3 = P positive overlapping; (20% of spool stroke) A, B, T, negative overlapping</p>		<p>Hydraulic options, see section 3: B = solenoid side of port A (only for valve configuration 5)</p> <p>Spool size: 1, 3, 5 = see section 3</p>														
<p>Spool type (regulating characteristics) L = linear; S = progressive; D = differential-progressive (as S, but with P-A= Q, P-B= Q/2)</p>																

2 ELECTRONIC DRIVERS FOR DHZE-A*

Drivers model	E-MI-AC		E-MI-AS-IR		E-BM-AC		E-BM-AS-PS		E-ME-AC	E-RP-AC	
Type	analog		digital		analog		digital		analog	analog	
Voltage supply	12	24	12	24	12	24	12	24	24	12	24
Coil option	/6	std	/6	std	/6	std	/6	std	std	/6	std
Format	DIN 43650 plug-in to solenoid				DIN 43700 UNDECAL		DIN-rail panel		EUROCARD	Sealed and rugged box	
Data sheet	G010		G020		G025		G030		G035	G100	

3 HYDRAULIC CHARACTERISTICS (based on mineral oil ISO VG 46 at 50 °C)

Hydraulic symbols					
Valve model	DHZE			DKZE	
Spool overlapping	1	1, 3	1, 3	1, 3	1, 3
Spool type and size (2)	L1	S3, L3, D3	S5, L5, D5	S3, L3, D3	S5, L5, D5
Pressure limits [bar]	ports P, A, B = 350; T = 210			ports P, A, B = 315; T = 210	
Max flow (3) [l/min]					
at $\Delta p = 10$ bar (P-T)	4,5	17	28	45	60
at $\Delta p = 30$ bar (P-T)	8	30	50	80	105
at $\Delta p = 70$ bar (P-T)	12	45	74	120	160
Response time (4) [ms]	< 30			< 40	
Hysteresis [%]	5%			5%	
Repeatability	$\pm 1\%$			$\pm 1\%$	

Notes:

- Above performance data refer to valves coupled with Atos electronic drivers, see section 2.
 - The flow regulated by the directional proportional valves is not pressure compensated, thus it is affected by the load variations. To keep constant the regulated flow under different load conditions, modular pressure compensators are available (see tab. D150).
- (1) **Option /B** Solenoid at side of port A, only for valve configuration 5.
- (2) **L** = linear flow characteristics
S = progressive flow characteristics
D = progressive flow characteristics with differential ratio P-A=Q; P-B = Q/2
- (3) For different Δp , the max flow is in accordance to the diagrams in sections 7.3 and 8.3
- (4) 0-100% step signal

4 MAIN CHARACTERISTICS

Assembly position	Any position					
Subplate surface finishing	Roughness index Ra 0,4 - flatness ratio 0,01/100 (ISO 1101)					
Ambient temperature	-20°C ÷ +70°C					
Fluid	Hydraulic mineral oil HL, HLP as per DIN 51524					
Recommended viscosity	15 ÷ 100 mm ² /s - max allowed range 2,8 ÷ 500 mm ² /s					
Fluid contamination class	ISO 4406 class 20/18/15 NAS 1638 class 9, in line filters of 10 μm ($\beta_{10} \geq 75$ recommended)					
Fluid temperature	-20°C +60°C (standard seals) -20°C +80°C (/PE seals)					
Coil code		DHZE-A*			DKZE-A*	
	standard	option /6 (1)	option /18 (2)	standard	option /6 (1)	option /18 (2)
Coil resistance R at 20°C	3 ÷ 3,3 Ω	2 ÷ 2,2 Ω	13 ÷ 13,4 Ω	3,8 ÷ 4,1 Ω	2,2 ÷ 2,4 Ω	12 ÷ 12,5 Ω
Max. solenoid current	2,2 A	2,75 A	1 A	2,6 A	3,25 A	1,2 A
Max. power	30 Watt			35 Watt		
Protection degree (CEI EN-60529)	IP65					
Duty factor	Continuous rating (ED=100%)					

Notes:

- (1) **Option /6** optional coil for Atos drivers with power supply 12 V_{DC}
- (2) **Option /18** optional coil for electronic drivers not supplied by Atos, with power supply 24 V_{DC} and max current limited to 1,2 A

5 GENERAL NOTES

DHZE and DKZE proportional valves 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 valve (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).

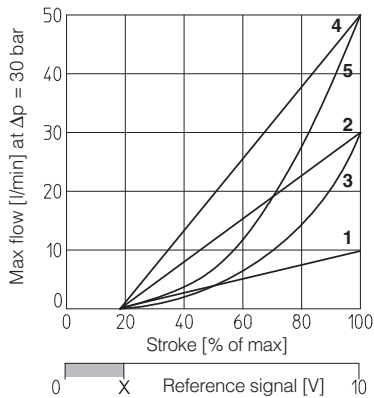
6 CONNECTIONS

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

7 DIAGRAMS FOR DHZE (based on mineral oil ISO VG 46 at 50 °C)

7.1 Regulation diagrams

- 1 = linear spool L1
- 2 = linear spool L3
- 3 = progressive spool S3, D3
- 4 = linear spool L5
- 5 = progressive spool S5, D5

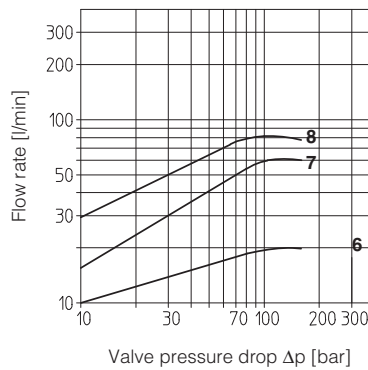


X = Threshold for bias activation depending to the valve type and amplifier type

7.2 Flow /Δp diagrams

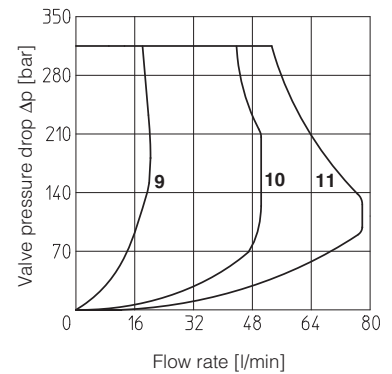
stated at 100% of valve stroke

- 6 = spool L1
- 7 = spool S3, L3, D3
- 8 = spool S5, L5, D5



7.3 Operating limits

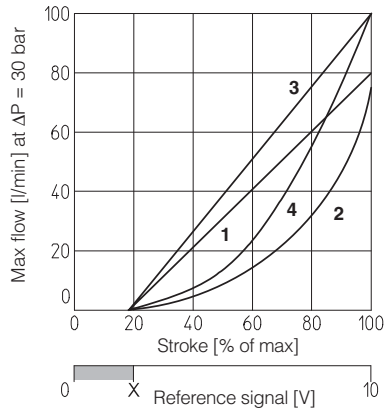
- 9 = spool L1
- 10 = spool L3, S3, D3
- 11 = spool L5, S5, D5



8 DIAGRAMS FOR DKZE (based on mineral oil ISO VG 46 at 50 °C)

8.1 Regulation diagrams

- 1 = linear spool L3
- 2 = progressive spool S3, D3
- 3 = linear spool L5
- 4 = progressive spool S5, D5

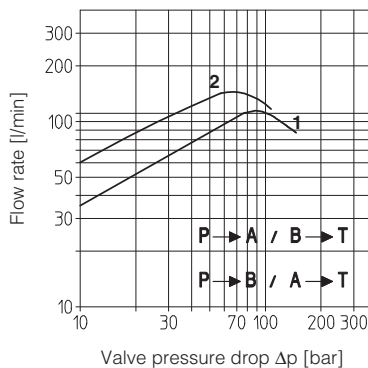


X = Threshold for bias activation depending to the valve type and amplifier type

8.2 Flow /Δp diagrams

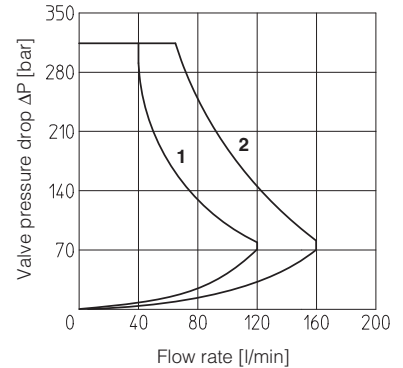
stated at 100% of valve stroke

- 1 = spool S3, L3, D3
- 2 = spool S5, L5, D5



8.3 Operating limits

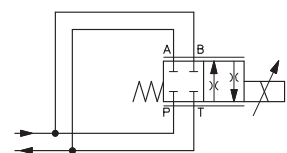
- 1 = spool L3, S3, D3
- 2 = spool L5, S5, D5



9 OPERATION AS THROTTLE VALVE

Single solenoid valves (DHZE-A-051 - DKZE-A-151) can be used as simple throttle valves:
Pmax = 210 bar

Max flow Δp= 30bar [l/min]	SPOOL TYPE				
	L1	L3	S3	L5	S5
DHZE	16	80		100	
DKZE	-	100		160	



10 INSTALLATION DIMENSIONS FOR DHZE and DKZE [mm]

ISO 4401: 2005

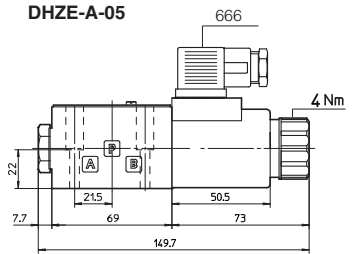
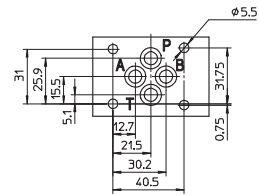
Mounting surface: 4401-03-02-0-05 (see table P005)

Fastening bolts: 4 socket head screws M5x50 class 12.9

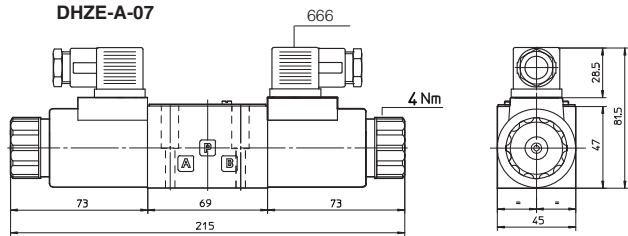
Tightening torque = 8 Nm

Seals: 4 OR 108

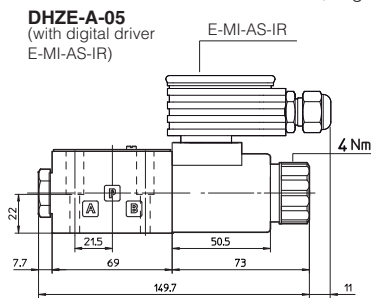
Diameter of ports A, B, P, T: \varnothing 7,5 mm (max)



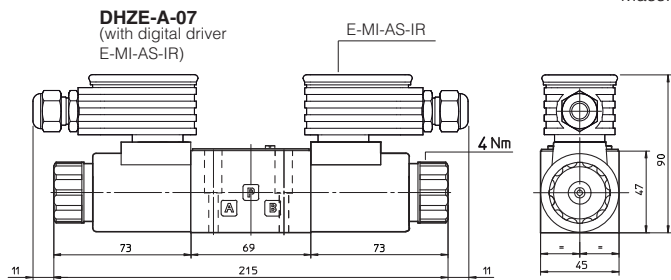
Mass: 1,5 kg



Mass: 2 kg



Mass: 1,95 kg



Mass: 3 kg

ISO 4401: 2005

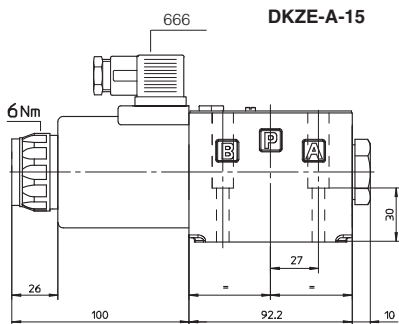
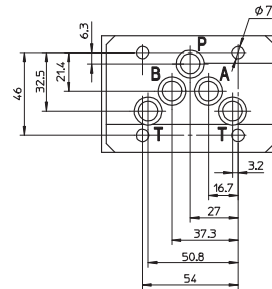
Mounting surface: 4401-05-04-0-05 (see table P005)

Fastening bolts: 4 socket head screws M6x40 class 12.9

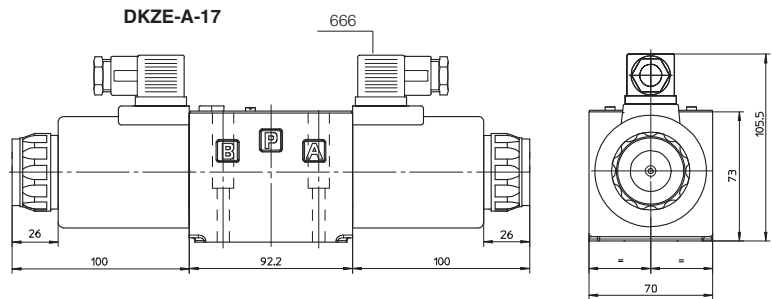
Tightening torque = 15 Nm

Seals: 5 OR 2050

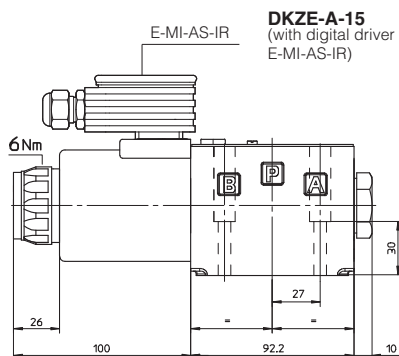
Diameter of ports A, B, P, T: \varnothing 11,2 mm (max)



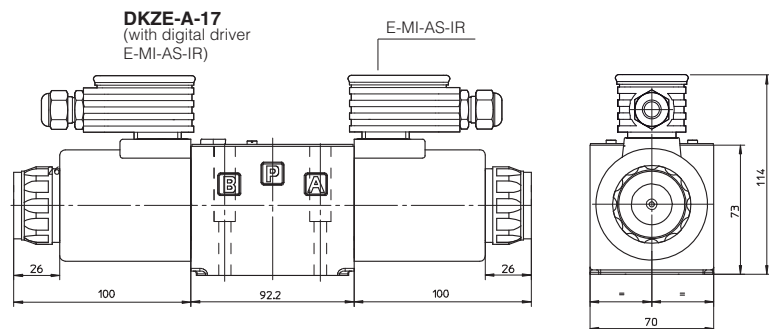
Mass: 4,5 kg



Mass: 6,1 kg



Mass: 4,95 kg

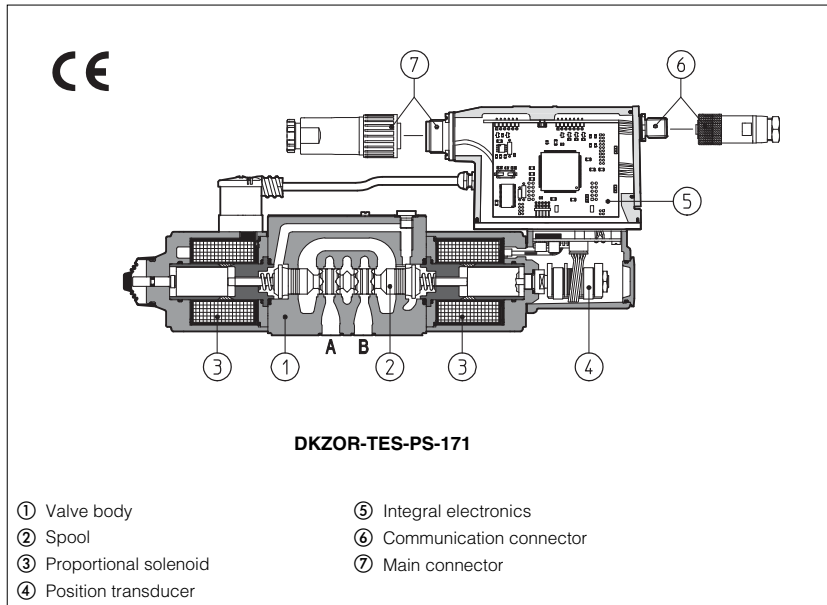


Mass: 7 kg

Note: for option /B the solenoid is at side of port A (only for DHZE-A-05 and DKZE-A-15)

Proportional directional valves type DHZO-T* and DKZOR-T*

direct operated, with position transducer, ISO 4401 size 06 and 10



1 MODEL CODE

DHZO - TES - PS - 0 7 1 - S 5 / * / ** / *

<p>DHZO = size 06 DKZOR = size 10</p> <p>T = with position transducer TE = as T plus integral analog electronics TES = as T plus integral digital electronics</p> <p>Communication interfaces (only for TES) PS = Serial BC = CANopen BP = PROFIBUS DP</p> <p>Valve size 0 = ISO 4401 size 06 1 = ISO 4401 size 10</p> <p>Configuration, see section 3 5 = external plus central position, spring centered 7 = 3 position, spring centered</p> <p>Spool overlapping in central position, see section 3 0 = zero overlapping (0 to 5 % spool stroke) (1) 1 = P,A,B,T positive overlapping (20% of spool stroke) 2 = P,A,B,T positive overlapping with A-B draining (2) 3 = P positive overlapping (20% of spool stroke); A, B, T, negative</p> <p>Spool type (regulating characteristics) L = linear; S = progressive; D = differential-progressive (as S, but with P-A = Q, P-B = Q/2) Q = linear spool, for alternate P/Q controls (3) V = differential-progressive, for alternate P/Q controls (3)</p> <p>Spool size: 14, 1, 2, 3, 5, 9 = see section 3</p>	<p>Synthetic fluids WG = water-glycol PE = phosphate ester</p> <p>Series number</p> <p>Hydraulic options, see section 4: B = solenoid, integral electronics and position transducer at side of port A Y = external drain</p> <p>Electronics options, for -TE execution see section 7: F = fault signal I = current reference input and monitor (4÷20 mA) Q = enable signal K = with logic state signals Z = enable, fault and monitor signals (12 pin connector)</p> <p>Electronics options, for -TES execution see section 7: I = current reference input and monitor (4÷20 mA) Z = double power supply, enable fault and monitor signals (12 pin connector)</p> <p>Special options for -TES execution see section 7: SF = additional closed loop force control, with two remote pressure transducers SL = additional closed loop force control with one remote load cell SP = additional closed loop pressure control with one remote pressure transducer C = current feedback interface for transducer(s) only for options /SF, /SL, /SP</p>
--	---

Notes:

- (1) For zero overlapping spool **0L3, 0L5, 0D5**, the valve offset position (with switch-off power supply) is 1 ÷ 6% P-B/A-T
- (2) Only for **DKZOR-S5** the spool overlapping type 2 provides the same characteristic of type 1, but in central position the internal leakages from P to A and B are drained to tank, avoiding the drift of cylinders with differential areas.
- (3) The spool type **Q** and **V** are used in combination with option /SP of digital integral drivers, see section 13.1, 14.1 and G212

2 ELECTRONIC DRIVERS

Valve model	-T	-TE	-TES	-TES / SF, SL, SP
Drivers model	E-ME-T	E-RI-TE	E-RI-TES	E-RI-TES/SF,SL,SP
Data sheet	G140	G200	G210	G212

Note: For power supply and communication connector see section 16 and 16

DHZO-T* and DKZOR-T* are proportional valves, direct operated, with LVDT position transducer, which provide both directional and non-compensated flow control according to the electronic reference signal.

They operate in association with electronic drivers, see section 2, which supply the proportional valves with proper current to align valve regulation to the reference signal supplied to the electronic driver.

They are available in different executions:

- -T, with integral position transducer ④;
- -TE, -TES as -T plus analog (TE) or digital (TES) integral electronics ⑤.

The 4-way spool ②, sliding into a 5-chambers body ①, is directly operated by solenoids ③ and it is controlled in closed loop position by means of the LVDT position transducer ④

The integral electronics ⑤ ensures factory presetting, fine functionality plus valve-to-valve interchangeability and simplified wiring and installation.

The electronic main connector ⑦ is fully interchangeable for -TE and -TES executions.

Standard 7 pin main connector is used for power supply, analog input reference and monitor signals.

12 pin connector is used for options /K, /Z and /S*.

The special /S* options add a closed loop control of pressure (/SP) or force (/SF and /SL) to the basic closed loop spool position one.

Following communication interfaces ⑥ are available for the digital -TES execution:

- -PS, Serial communication interface. The valve reference signal is provided with analogue commands
- -BC, CANopen interface
- -BP, PROFIBUS DP interface

The valves with -BC and -BP interfaces can be integrated into a fieldbus communication network and thus digitally operated by the machine control unit.

The coils are fully plastic encapsulated (insulation class H) and the valves have antivibration, antishock and weather-proof features.

Mounting surface: ISO 4401 sizes 06 and 10.

Max flow respectively up to 50 l/min and 130 l/min with valve differential pressure $\Delta p = 30$ bar, see table 3.

Max pressure = 350 bar for DHZO;
315 bar for DKZOR.

3 HYDRAULIC CHARACTERISTICS (based on mineral oil ISO VG 46 at 50 °C)

Hydraulic symbols					
Valve model	DHZO-T*				DKZOR-T*
Spool overlapping	-T -TE -TES				-T -TE -TES
Spool type and size	1, 3	1, 3	1, 3	1, 3	3
Pressure limits [bar]	ports P, A, B = 350; T = 210 (250 with external drain /Y)				ports P, A, B = 315; T = 210 (250 with external drain /Y)
Max flow (1) [l/min]					
at Δp = 10 bar (P-T)	1	4,5	8	17	28
at Δp = 30 bar (P-T)	2	8	14	30	50
at Δp = 70 bar (P-T)	3	12	21	45	74
Response time [ms]	< 15				< 20
Hysteresis [%]	≤ 0,2%				≤ 0,2%
Repeatability [%]	± 0,1%				± 0,1%
Thermal drift	zero point displacement < 1% at ΔT = 40°C				

Notes:

- Above performance data refer to valves coupled with Atos electronic drivers, see sections 2.
 - The flow regulated by the directional proportional valves is not pressure compensated, thus it is affected by the load variations. To keep constant the regulated flow under different load conditions, modular pressure compensators are available (see tab. D150).
- (1) For different Δp, the max flow is in accordance to the diagrams in sections 13.2 and 14.2

4 HYDRAULIC OPTIONS

- 4.1 Option /B** Solenoid (for valve configuration *5*), integral electronics and position transducer at side of port A.
- 4.2 Option /Y** External drain advisable when the valve is used in double flow path, see section 13.5 and 14.5. Option /Y is mandatory if the pressure in port T exceeds 160 bar.

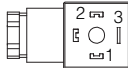
5 GENERAL NOTES

DHZO and DKZOR proportional valves 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.

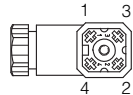
The electrical signals of the valve (e.g. monitor signals) must not be directly used to activate safety functions, like to switch-ON/OFF the machine's safety components, as prescribed by the European standards (Safety requirements of fluid technology systems and components-hydraulics, EN-892).

6 CONNECTIONS FOR -T EXECUTION

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



POSITION TRANSDUCER CONNECTOR	
PIN	Signal description
1	OUTPUT SIGNAL
2	SUPPLY -15 V _{DC}
3	SUPPLY +15 V _{DC}
4	GND



7 ANALOG INTEGRAL DRIVERS -TE - OPTIONS

Standard driver execution provides on the 7 pin main connector:

- Power supply** - 24V_{DC} must be appropriately stabilized or rectified and filtered; a 2,5 A safety fuse is required in series to the driver power supply. Apply at least a 10000 μF/40 V capacitance to single phase rectifiers or a 4700 μF/40 V capacitance to three phase rectifiers
- Reference input signal** - analog differential input with ±10 V_{DC} nominal range (pin D,E), proportional to desired valve spool position
- Monitor output signal** - analog output signal proportional to the actual valve's spool position with ±10 V_{DC} nominal range

Following options are available to adapt standard execution to special application requirements:

7.1 Option /F

It provides a Fault output signal in place of the Monitor output signal, to indicate fault conditions of the driver (cable interruption of spool transducers or reference signal - for /I option): Fault presence corresponds to 0 V_{DC}, normal working corresponds to 24 V_{DC}.

7.2 Option /I

It provides the 4±20 mA current reference and monitor signals instead of the standard ±10 V_{DC}. It 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.

7.3 Option /Q

It provides the possibility to enable or disable the valve functioning without cutting the power supply (the valve functioning is disabled but the driver current output stage is still active). To enable the driver supply a 24V_{DC} on the enable input signal.

7.4 Option /Z

This option includes /F and /Q features, plus the Monitor output signal. When the driver is disabled (0 V_{DC} on enable signal) Fault option is forced to 0 V_{DC}.

7.5 Option /K (only for DHZO-TE-071* and DKZOR-TE-171*)

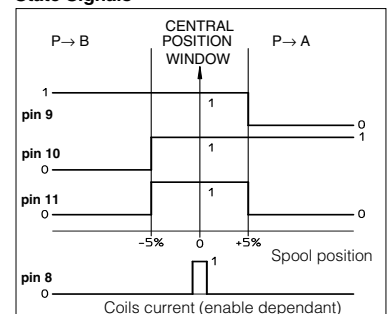
This option provides, by means of four ON/OFF output signals, a real time monitor of the valve's hydraulic regulation (P-A, P-B or Central) and of the solenoid energizing status. It can be used to improve the system safety level, by interfacing the four signals to a specific CE certified electronics: beside the standard safety valves the machine CNC can also recognize the proportional valve regulation during the working cycle.

The valve regulation is identified by the contemporaneous status on the four signals, as shown in the beside diagram. The central position indicates no hydraulic regulation: "central position window" is located across the valve's mechanical zero within ± 5% of the total stroke and it provides a reliable information about the actuator stopped condition (valve's spools have a nominal positive overlap of ± 20% of total stroke). The signal on pin 8 identifies the solenoid energizing status and depends on enable signal status (see 6.3): "0" = coil current active and "1" = coil current zero (enable signal must be 0V_{DC}).

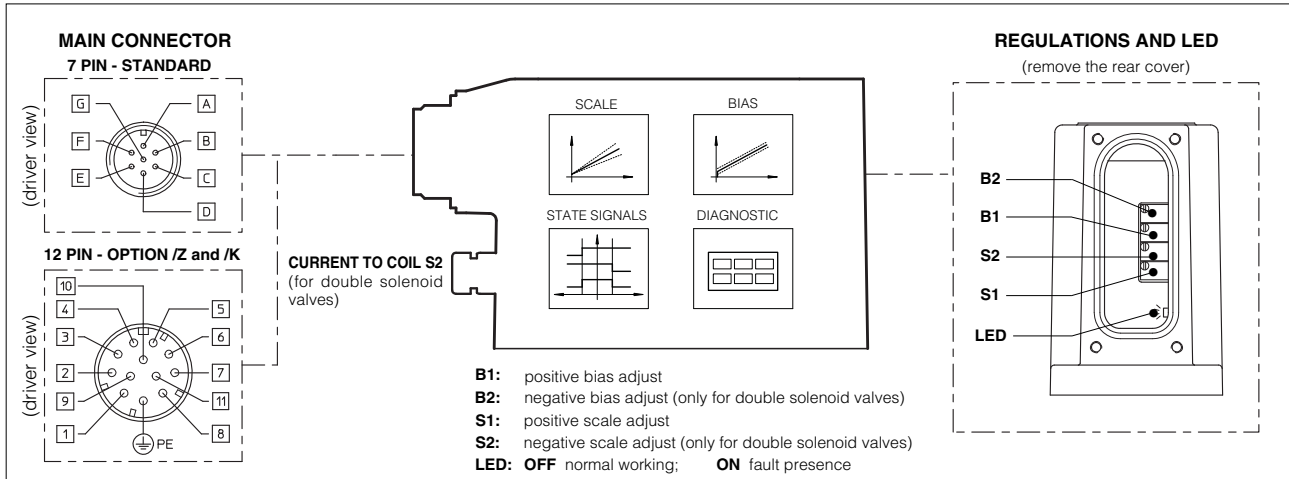
For all signals, the logic state "0" produces an output voltage signal ≤ 1 V_{DC} while the logic state "1" produces an output voltage signal ≥ 22 V_{DC}.

7.6 Possible combined options: /FI, /IK and /IZ

State Signals



8 ANALOG INTEGRAL DRIVERS -TE - MAIN FUNCTIONS AND ELECTRONIC CONNECTIONS



8.1 ELECTRONIC CONNECTIONS - 7 & 12 PIN MAIN CONNECTORS

Standard 7pin	/Z,/K option 12pin	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
A	1	V+	Power supply 24 Vdc for solenoid power stage and driver logic	Input - power supply
B	2	V0	Power supply 0 Vdc for solenoid power stage and driver logic	Gnd - power supply
C (1)	7	AGND	Ground - signal zero for MONITOR signal (for standard, /Z and /K options)	Input - analog signal
	3	ENABLE	Enable (24 Vdc) or disable (0 Vdc) the driver (for /Q, /Z and /K options)	Input - on/off signal
D	4	INPUT+	Reference analog differential input: ± 10 Vdc maximum range (4 \div 20 mA for /I option)	Input - analog signal
E	5	INPUT -	For single solenoid valves the reference input is 0 \div +10 Vdc (4 \div 20 mA for /I option) For double solenoid valves the reference input is ± 10 Vdc (4 \div 20 mA for /I option)	
F (2)	6	MONITOR	Monitor analog output: ± 10 Vdc maximum range (4 \div 20 mA for /I option)	Output - analog signal
	11	FAULT	Fault (0V) or normal working (24V) (for /F and /Z, see 7.5 for /K option)	Output - on/off signal
-	8	R_ENABLE	Repeat Enable - output repetition of Enable input (see 7.5, for /K option)	Output - on/off signal
-	9	NC	do not connect (see 7.5, for /K option)	Output - on/off signal
-	10	NC	do not connect (see 7.5, for /K option)	Output - on/off signal
G	PE	EARTH	Internally connected to the driver housing	

Notes

(1) with /Q option ENABLE signal replaces AGND on pin C; MONITOR signal is referred to pin B

(2) with /F option FAULT signal replaces MONITOR on pin F.

- A minimum time of 50ms to 100ms 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.

9 DIGITAL INTEGRAL DRIVERS -TES - OPTIONS

Standard driver execution provides on the 7 pin main connector:

- Power supply** - 24Vdc must be appropriately stabilized or rectified and filtered; a 2,5 A safety fuse is required in series to each driver power supply
Apply at least a 10000 μ F/40 V capacitance to single phase rectifiers or a 4700 μ F/40 V capacitance to three phase rectifiers.
- Reference input signal** - analog differential input with ± 10 Vdc nominal range (pin D,E), proportional to desired valve spool position
- Monitor output signal** - analog output signal proportional to the actual valve's spool position with ± 10 Vdc nominal range

Following options are available to adapt standard execution to special application requirements:

9.1 Option /I

It provides 4 \div 20 mA current reference and monitor signals instead of the standard ± 10 V.

It 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.

9.2 Option /Z

It provides on a 12 pin main connector the above standard features plus:

Logic power supply

Option /Z provides 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. This condition allows to realize safety systems in compliance with European Norms EN13849-1 (ex EN954-1).

Enable Input Signal

To enable the driver, supply a 24Vdc on pin 3 referred to pin 2: when the Enable signal is set to zero the valve functioning is disabled (zero current to the solenoid) but the driver current output stage is still active. This condition does not comply with European Norms EN13849-1 (ex EN954-1).

Fault Output Signal

Fault output signal indicates fault conditions of the driver (solenoid short circuits/not connected, reference signal cable broken for 4 \div 20mA input, etc.). Fault presence corresponds to 0 Vdc, normal working corresponds to 24Vdc (pin 11 referred to pin 2): Fault status is not affected by the Enable input signal

9.3 Options /SP, /SF and /SL

These options add the closed loop control of pressure (/SP) or force (/SF and /SL) to the basic functions of proportional directional valves: a dedicated software alternates pressure (force) and valve's spool position controls depending on the actual hydraulic system conditions.

A dedicated connector is available for the additional transducers that are required to be interfaced to the valve's driver (1 pressure transducer for /SP, 2 pressure transducers for /SF or 1 load cell for /SL).

Main 12 pin connector is the same as /Z option plus two analog signals specific for the pressure (force) control: one for reference (pin 7) and one for monitor (pin 8).

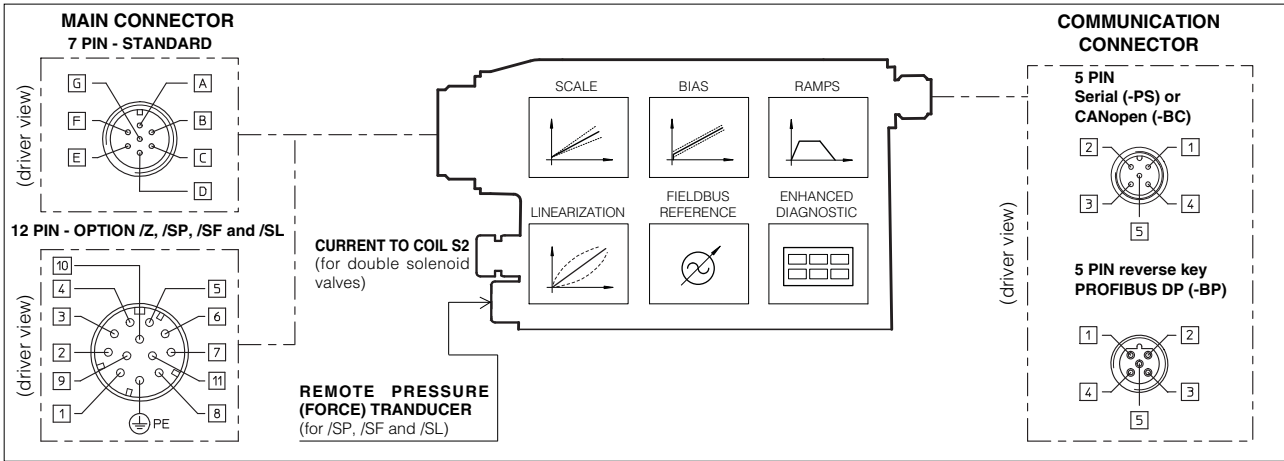
For further details please refer to the driver technical table **G212**.

9.4 Options /C

Options /CSP, /CSF and /CSL are available to connect pressure (force) transducers with 4 \div 20mA current output signal.

9.5 Possible combined options: /ISP, /ISF, /ISL, /ICSP, /ICSF, /ICSL, /CISP, /CISF, /CISL and /IZ

10 DIGITAL INTEGRAL DRIVERS -TES - MAIN FUNCTIONS AND ELECTRONIC CONNECTIONS



10.1 ELECTRONIC CONNECTIONS - 7 & 12 PIN MAIN CONNECTORS

Standard 7pin	/Z option 12pin	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
A	1	V+	Power supply 24 Vdc for solenoid power stage (and for driver logic on 7 pin connection)	Input - power supply
B	2	V0	Power supply 0 Vdc for solenoid power stage (and for driver logic on 7 pin connection)	Gnd - power supply
-	3	ENABLE	Enable (24 Vdc) or disable (0 Vdc) the driver	Input - on/off signal
D	4	INPUT+	Reference analog input: ± 10 Vdc maximum range ($4 \div 20$ mA for /I option)	Input - analog signal
E	-	INPUT -	For single solenoid valves the reference input is $0 \div +10$ Vdc ($4 \div 20$ mA for /I option) For double solenoid valves the reference input is ± 10 Vdc ($4 \div 20$ mA for /I option) standard: differential input; /Z option: common mode INPUT+ referred to AGND	
C	5	AGND	Ground - signal zero for MONITOR signal signal zero for INPUT+ signal (only for /Z option)	Gnd - analog signal
F	6	MONITOR	Monitor analog output: ± 10 Vdc maximum range ($4 \div 20$ mA for /I option)	Output - analog signal
-	7	NC	do not connect (pressure/force input for /SP, /SF and /SL options, see 9.3)	
-	8	NC	do not connect (pressure/force monitor for /SP, /SF and /SL options, see 9.3)	
-	9	VL+	Power supply 24 Vdc for driver logic	Input - power supply
-	10	VLO	Power supply 0 Vdc for driver logic	Gnd - power supply
-	11	FAULT	Fault (0V) or normal working (24V)	Output - on/off signal
G	PE	EARTH	Internally connected to the driver housing	

Note: 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.

10.2 ELECTRONIC CONNECTIONS - 5 PIN COMMUNICATION CONNECTORS

PIN	-PS Serial		-BC CANopen		-BP PROFIBUS DP	
	SIGNAL	TECHNICAL SPECIFICATION	SIGNAL	TECHNICAL SPECIFICATION	SIGNAL	TECHNICAL SPECIFICATION
1	NC	do not connect	CAN_SHLD	Shield	+5V	for termination
2	NC	do not connect	NC	do not connect	LINE-A	Bus line (high)
3	RS_GND	Signal zero data line	CAN_GND	Signal zero data line	DGND	data line and termination Signal zero
4	RS_RX	Valves receiving data line	CAN_H	Bus line (high)	LINE-B	Bus line (low)
5	RS_TX	Valves transmitting data line	CAN_L	Bus line (low)	SHIELD	

11 SOFTWARE TOOLS

The functional parameters of digital valves, as the bias, scale ramp and linearization of the regulation characteristic, can be easily set and optimized with the Atos E-SW programming software, available in three different versions according to the driver's communication interfacing: E-SW-PS (Serial), E-SW-BC (CANopen) and E-SW-BP (PROFIBUS DP).

A proper connection is required between the PC and the electronic driver communication port: for a more detailed description of software interface, PC requirements, adapters, cables and terminators, please **see table G500**.

Proportional valves with fieldbus communication interface (-BC and -BP) can be directly managed by the machine control unit; it is required to implement in the machine control the standard communication as described in the user manuals supplied with the relevant programming software. For detailed description of available fieldbus feature, **see table G510**.

On first supply of the E-SW software, it is required to apply for the registration in the Atos download area: www.download.atos.com

Once the registration is completed, the password will be sent by email.

The software remains active for 10 days from the installation date and then it stops until the user inputs his password.

With the password you can also download, in your personal area, the latest releases of the Atos software, manuals, drivers and configuration files.

12 MAIN CHARACTERISTICS OF PROPORTIONAL DIRECTIONAL VALVES

Assembly position	Any position	
Subplate surface finishing	Roughness index, \sqrt{Ra} flatness ratio 0,01/100 (ISO 1101)	
Ambient temperature	-20°C \div +70°C for -T execution; -20°C \div +60°C for -TE and TES executions	
Fluid	Hydraulic oil as per DIN 51524 ... 535 for other fluids see section 11	
Recommended viscosity	15 \div 100 mm ² /s at 40°C (ISO VG 15 \div 100)	
Fluid contamination class	ISO 18/15 achieved with in line filters of 10 μ m and $\beta_{10} \geq 75$ (recommended)	
Fluid temperature	-20°C +60°C (standard and /WG seals) -20°C +80°C (/PE seals)	
Valve model	DHZO-T*	DKZOR-T*
Coil resistance R at 20°C	3 \div 3,3 Ω	3,8 \div 4,1 Ω
Max. solenoid current	2,6 A	3 A
Max. power	35 Watt	40 Watt
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 (CEI EN-60529)	IP65 for -T execution; IP65 \div 67 for -TE and -TES executions, depending to the connector type (see sect. 116 118)	
Duty factor	Continuous rating (ED=100%)	

13 DIAGRAMS FOR DHZO (based on mineral oil ISO VG 46 at 50 °C)

13.1 Regulation diagrams

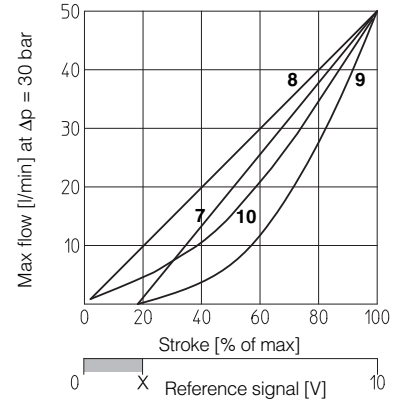
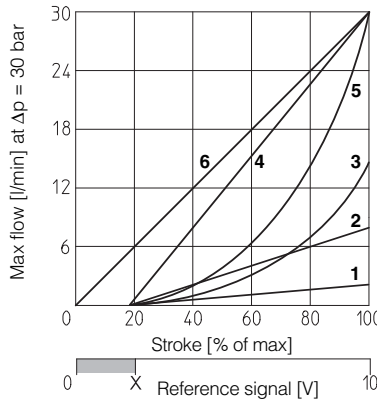
- 1 = linear spool L14
- 2 = linear spool L1
- 3 = progressive spool S2
- 4 = linear spool L3
- 5 = progressive spool S3, D3
- 6 = linear spool, zero overlapping OL3
- 7 = linear spool L5
- 8 = linear spool, zero overlapping OL5
- 9 = progressive spool S5, D5
- 10 = progressive spool, zero overlapping OD5

Note:

Hydraulic configuration vs. reference signal for double solenoid valves (also for option /B)

Reference signal $0 \div +10\text{ V}$ $12 \div 20\text{ mA}$ P → A / B → T

Reference signal $0 \div -10\text{ V}$ $4 \div 12\text{ mA}$ P → B / A → T



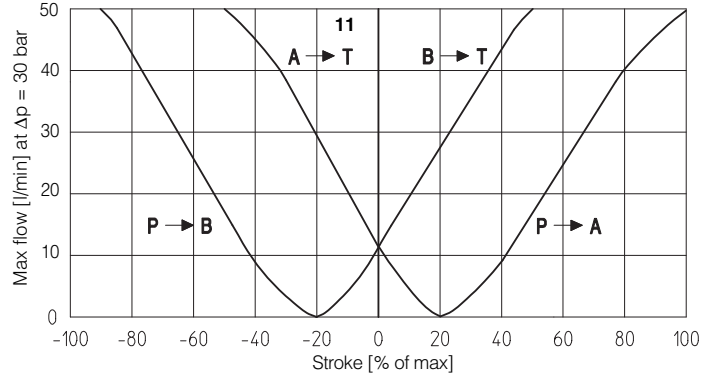
X = Threshold for bias activation depending to the valve type and amplifier type

11 = linear spool Q5

Q5 spool type is specific for alternate P/Q controls in combination with /SP option of digital integral drivers, see tab. G212

It allows to control the pressure in A port or B port and it provides a safety central position (A-T/B-T) to depressurize the actuator chambers.

The strong meter-in characteristic makes the spool suitable for both pressure control and motion regulations in several applications.

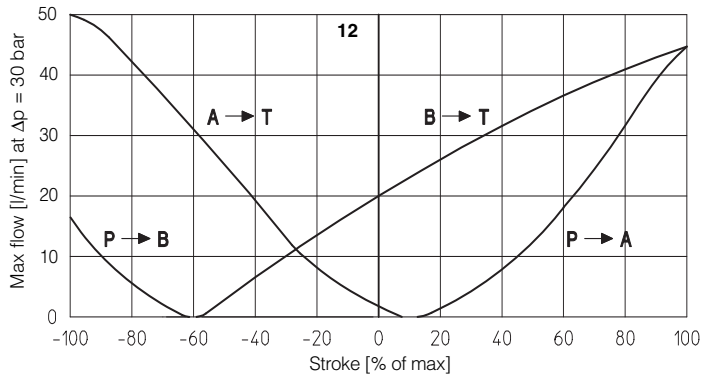


12 = differential - progressive spool V9

V9 spool type is specific for alternate P/Q controls in combination with /SP option of digital integral drivers, see tab. G212

This spool is specially designed to manage the whole injection cycle in plastic machinery, thanks to the following specific features:

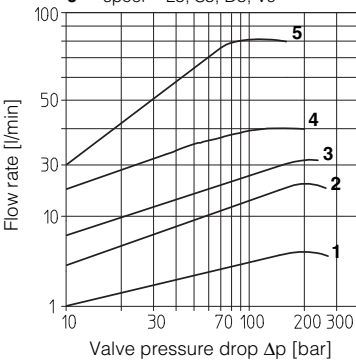
- strong meter-in characteristic to allow the pressure control in A port during the holding pressure (P-A) and the plasticizing (A-T) phases
- safety central position (A-T/B-T) to depressurize the actuator chambers
- large A-T and B-T flow capability, required during the plasticizing phase, to discharge big volumes from high differential injection cylinders with low pressure drops and permitting the contemporary oil suction from tank



13.2 Flow /Δp diagrams

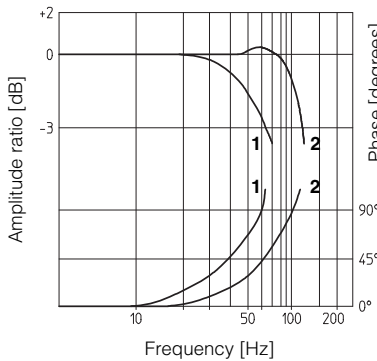
stated at 100% of valve stroke

- 1 = spool L14
- 2 = spool L1
- 3 = spool S2
- 4 = spool L3, S3, D3
- 5 = spool L5, S5, D5, V9



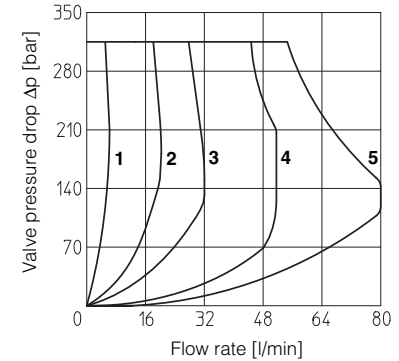
13.3 Bode diagrams

- 1 = 10% ↔ 90% nominal stroke
- 2 = 50% ± 5% nominal stroke



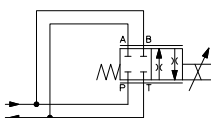
13.4 Operating limits

- 1 = spool L14
- 2 = spool L1
- 3 = spool S2
- 4 = spool L3, S3, D3
- 5 = spool L5, S5, D5, V9



13.5 Operation as throttle valve

Single solenoid valves (DHZO*-051) can be used as simple throttle valves: Pmax = 250 bar (option /Y advisable)



	SPOOL TYPE						
	L14	L1	S2	L3	S3	L5	S5
Max flow Δp= 70bar [l/min]	6	20	40	80	100		

13.6 Dynamic response

The response times in section 3 and the frequency responses in the bode diagrams have to be considered as average values. For the valves with digital electronics the dynamics performances can be optimized by setting the internal software parameters.

14 DIAGRAMS FOR DKZOR (based on mineral oil ISO VG 46 at 50 °C)

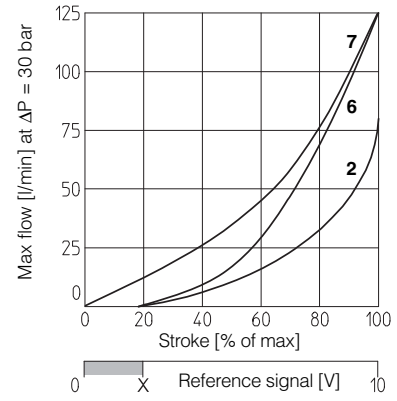
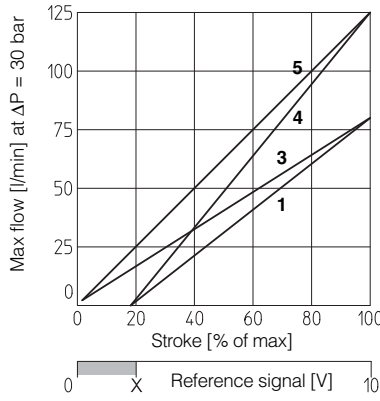
14.1 Regulation diagrams

- 1 = linear spool L3
- 2 = progressive spool S3, D3
- 3 = linear spool, zero overlapping OL3
- 4 = linear spool L5
- 5 = linear spool, zero overlapping OL5
- 6 = progressive spool S5, D5
- 7 = progressive spool, zero overlapping OD5

Note:

Hydraulic configuration vs. reference signal for double solenoid valves (also for option /B)

- Reference signal $0 \div +10\text{ V}$ $12 \div 20\text{ mA}$ P → A / B → T
- Reference signal $0 \div -10\text{ V}$ $4 \div 12\text{ mA}$ P → B / A → T



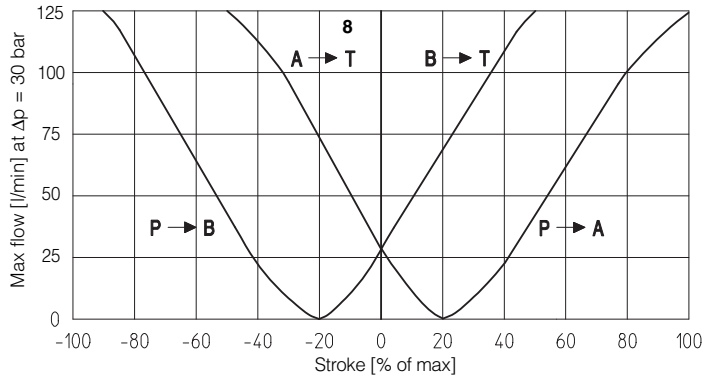
X = Threshold for bias activation depending to the valve type and amplifier type

8 = linear spool Q5

Q5 spool type is specific for alternate P/Q controls in combination with /SP option of digital integral drivers, see tab. G212

It allows to control the pressure in A port or B port and it provides a safety central position (A-T/B-T) to depressurize the actuator chambers.

The strong meter-in characteristic makes the spool suitable for both pressure control and motion regulations in several applications.

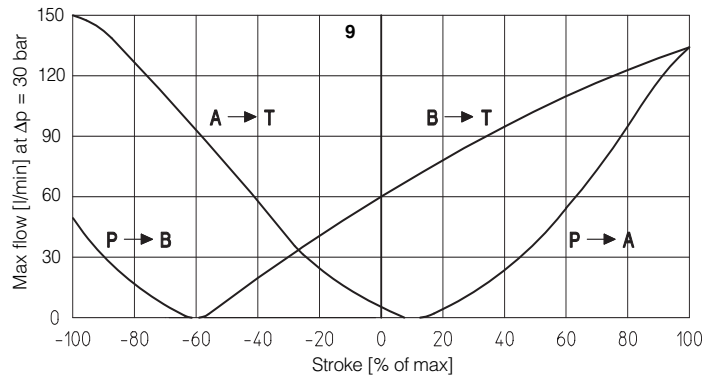


9 = differential - progressive spool V9

V9 spool type is specific for alternate P/Q controls in combination with /SP option of digital integral drivers, see tab. G212

This spool is specially designed to manage the whole injection cycle in plastic machinery, thanks to the following specific features:

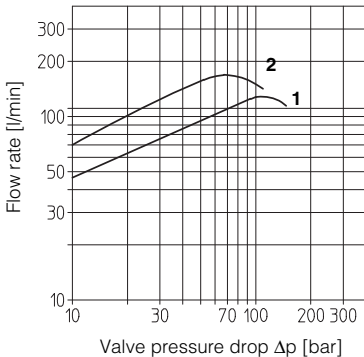
- strong meter-in characteristic to allow the pressure control in A port during the holding pressure (P-A) and the plasticizing (A-T) phases
- safety central position (A-T/B-T) to depressurize the actuator chambers
- large A-T and B-T flow capability, required during the plasticizing phase, to discharge big volumes from high differential injection cylinders with low pressure drops and permitting the contemporary oil suction from tank



14.2 Flow /Δp diagrams

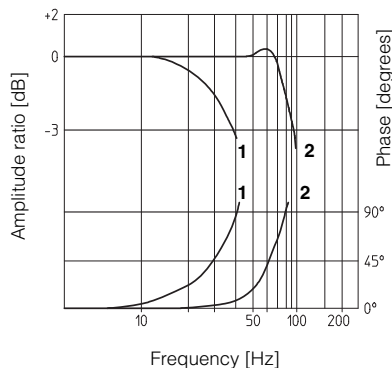
stated at 100% of valve stroke

- 1 = spool S3, L3, D3
- 2 = spool S5, L5, D5, V9



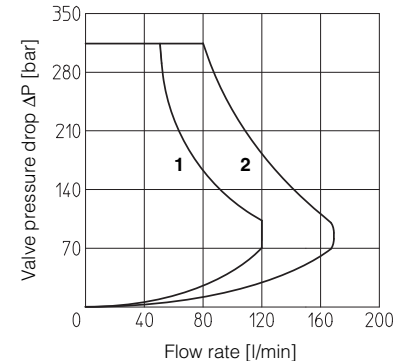
14.3 Bode diagrams

- 1 = 10% ↔ 90% nominal stroke
- 2 = 50% ± 5% nominal stroke



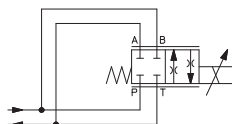
14.4 Operating limits

- 1 = spool L3, S3, D3
- 2 = spool L5, S5, D5, V9



14.5 Operation as throttle valve

Single solenoid valves (DKZOR*-151) can be used as simple throttle valves: Pmax = 250 bar (option /Y advisable)



	SPOOL TYPE			
	L3	S3	L5	S5
Max flow Δp= 30 bar [l/min]	150		250	

14.6 Dynamic response

The response times in section 3 and frequency responses in the bode diagrams have to be considered as average values. For the valves with digital electronics the dynamics performances can be optimized by setting the internal software parameters.

15 INSTALLATION DIMENSIONS FOR DHZO [mm]

ISO 4401: 2000

Mounting surface: 4401-03-02-0-05 (see table P005)

(for /Y surface 4401-03-03-0-05 without X port)

Fastening bolts: 4 socket head screws M5x50 class 12.9

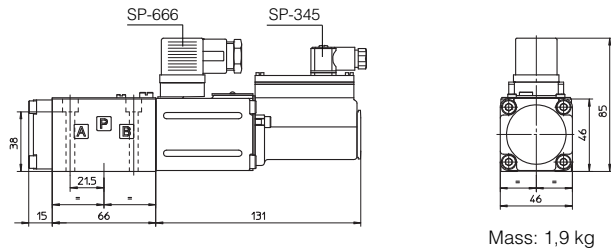
Tightening torque = 8 Nm

Seals: 4 OR 108; 1 OR 2025

Diameter of ports A, B, P, T: \varnothing 7,5 mm (max)

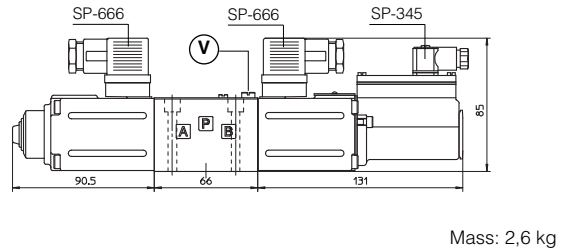
Diameter of port Y: \varnothing = 3,2 mm (only for /Y option)

DHZO-T-05



Mass: 1,9 kg

DHZO-T-07



Mass: 2,6 kg

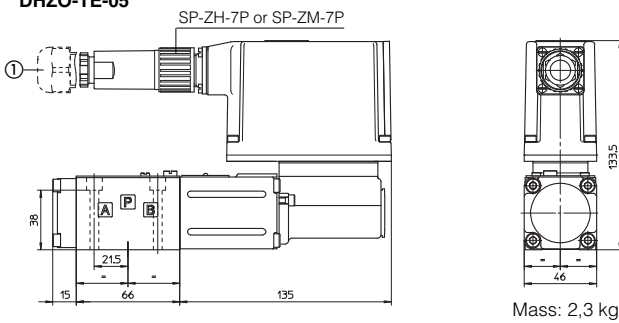
Note: for option /B the solenoid and the position transducer are at side of port A

(V) = Air bleed off

-TE EXECUTION

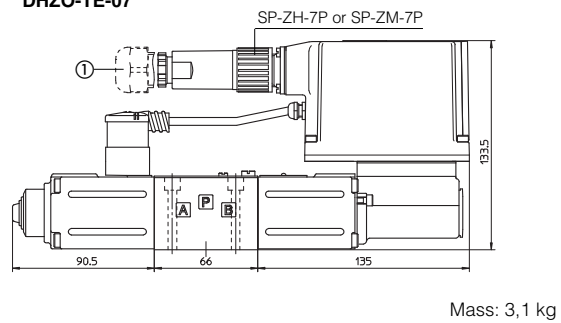
① Dotted line = 12 pin connector SP-ZH-12P for options /K and /Z

DHZO-TE-05



Mass: 2,3 kg

DHZO-TE-07



Mass: 3,1 kg

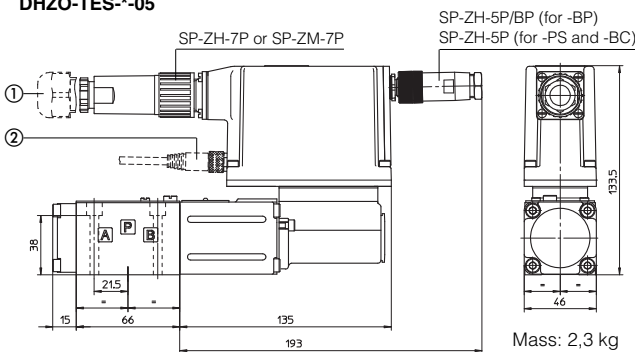
-TES EXECUTION

① Dotted line = 12 pin connector SP-ZH-12P for options /SF, /SL, /SP, /Z

② Dotted line = M8 connector SP-ZH-4P-M8/5 moulded on cable 5 mt lenght for pressure or force transducer (options /SL, /SP)

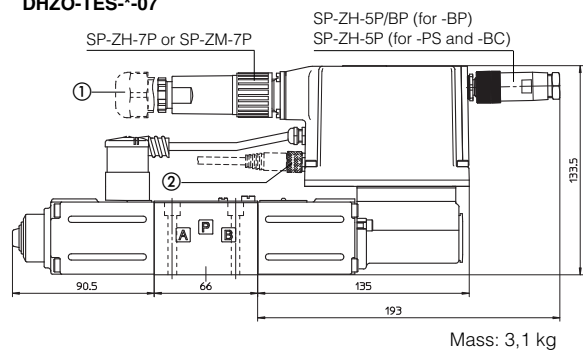
M8 connector SP-ZH-4P-M8/2-2 moulded with 2 cables, 2 mt lenght for 2 pressure transducers (options /SF)

DHZO-TES*-05



Mass: 2,3 kg

DHZO-TES*-07



Mass: 3,1 kg

Note: for option /B the solenoid, the position transducer and the integral electronics are at side of port A

16 MODEL CODES OF POWER SUPPLY AND COMMUNICATION CONNECTORS (to be ordered separately)

VALVE VERSION	-T Power supply Transducer		-TE, -TES		-TE/K, /Z -TES /Z, /SF, /SL, /SP	TES -PS, -BC	TES -BP	TES /SF, /SL, /SP
CONNECTOR CODE	SP-666	SP-345	SP-ZH-7P	SP-ZM-7P	SP-ZH-12P	SP-ZH-5P	SP-ZH-5P/BP	SP-ZH-4P-M8/* (1)
PROTECTION DEGREE	IP65	IP65	IP67	IP67	IP65	IP67	IP67	IP67
DATA SHEET	K500		G200, G210, K500			G210, K500		G212, K500

(1) M8 connector SP-ZH-4P-M8/5 moulded on cable 5 mt lenght for pressure or force transducer (options /SL, /SP)

M8 connector SP-ZH-4P-M8/2-2 moulded with 2 cables, 2 mt lenght for 2 pressure transducers (options /SF)

connectors supplied with the valve

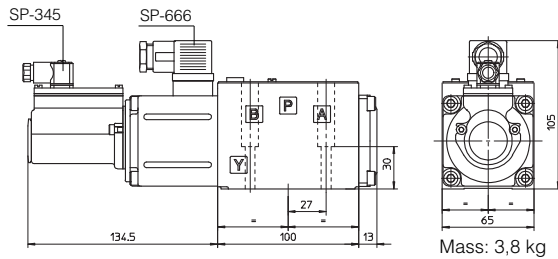
17 INSTALLATION DIMENSIONS FOR DKZOR [mm]

ISO 4401: 2000

Mounting surface: 4401-05-04-0-05 (see table P005)
(for /Y surface 4401-05-05-0-05 without X port)

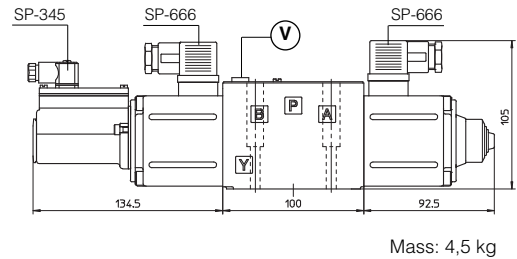
Fastening bolts: 4 socket head screws M6x40 class 12.9
 Tightening torque = 15 Nm
 Seals: 5 OR 2050; 1 OR 108
 Diameter of ports A, B, P, T: \varnothing 11,2 mm (max)
 Diameter of port Y: \varnothing = 5 mm (only for /Y option)

DKZOR-T-15



Mass: 3,8 kg

DKZOR-T-17



Mass: 4,5 kg

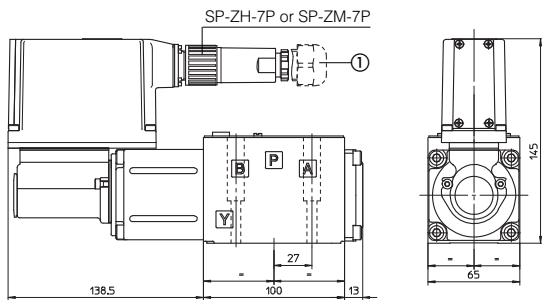
Note: for option /B the solenoid and the position transducer are at side of port A

$\text{\textcircled{V}}$ = Air bleed off

-TE EXECUTION

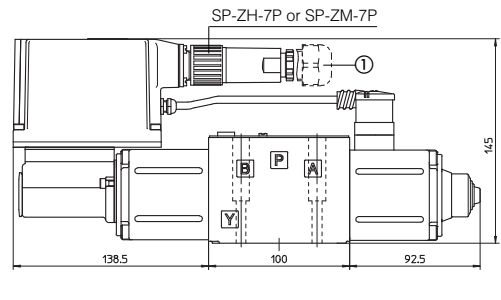
① Dotted line = 12 poles connector SP-ZH-12P for options /K and /Z

DKZOR-TE-15



Mass: 4,3 kg

DKZOR-TE-17

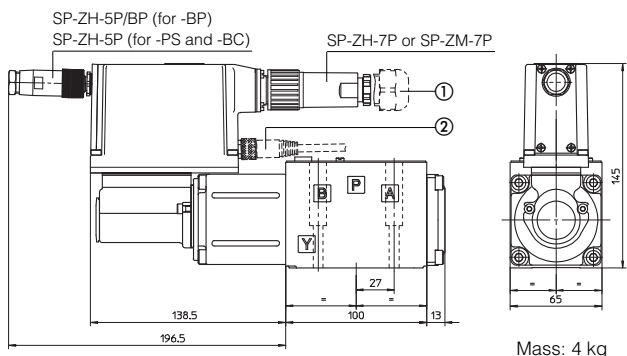


Mass: 5,0 kg

-TES EXECUTION

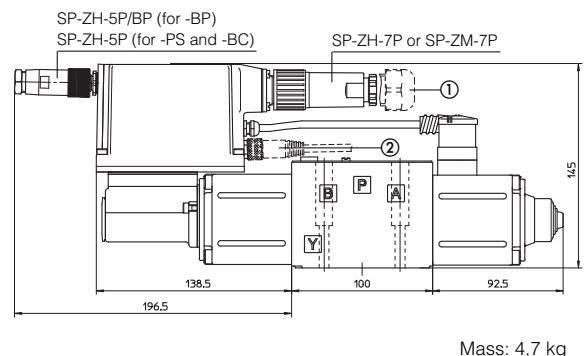
① Dotted line = 12 pin connector SP-ZH-12P for options /SF, /SL, /SP, /Z
 ② Dotted line = M8 connector SP-ZH-4P-M8/5 moulded on cable 5 mt length for pressure or force transducer (options /SL, /SP)
 M8 connector SP-ZH-4P-M8/2-2 moulded with 2 cables, 2 mt length for 2 pressure transducers (options /SF)

DKZOR-TES*-15



Mass: 4 kg

DKZOR-TES*-17



Mass: 4,7 kg

Note: for option /B the solenoid, the position transducer and the integral electronics are at side of port A

18 MODEL CODES OF POWER SUPPLY AND COMMUNICATION CONNECTORS (to be ordered separately)

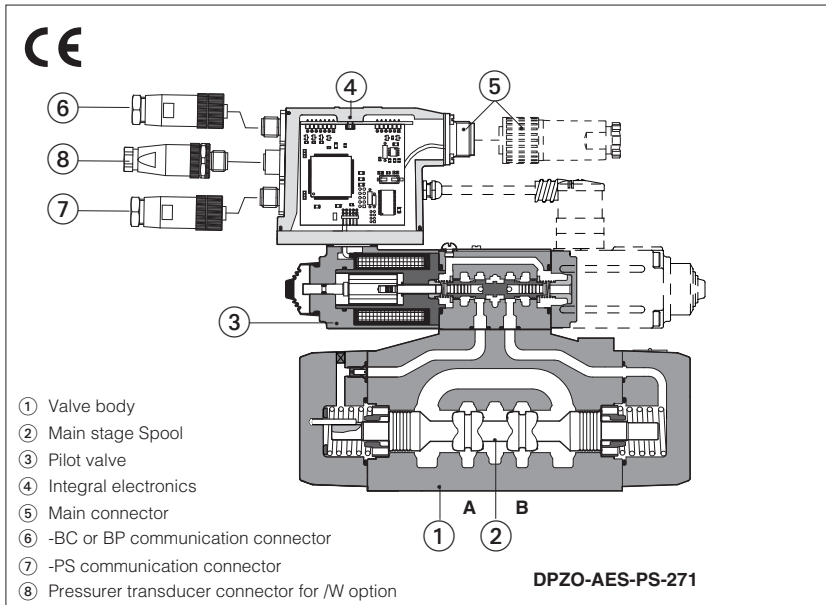
VALVE VERSION	-T		-TE, -TES		-TE/K, /Z	TES -PS, -BC	TES -BP	TES /SF, /SL, /SP
	Power supply	Transducer						
CONNECTOR CODE	SP-666	SP-345	SP-ZH-7P	SP-ZM-7P	SP-ZH-12P	SP-ZH-5P	SP-ZH-5P/BP	SP-ZH-4P-M8/* (1)
PROTECTION DEGREE	IP65	IP65	IP67	IP67	IP65	IP67	IP67	IP67
DATA SHEET	K500		G200, G210, K500			G210, K500		G212, K500

(1) M8 connector SP-ZH-4P-M8/5 moulded on cable 5 mt length for pressure or force transducer (options /SL, /SP)
 M8 connector SP-ZH-4P-M8/2-2 moulded with 2 cables, 2 mt length for 2 pressure transducers (options /SF)

connectors supplied with the valve

Proportional directional valves type DPZO-A*

two stage without position transducer, ISO 4401 sizes 10, 16, 25 and 32



1 MODEL CODE

DPZO - AES- PS - 2 7 1 - D 5 / * * * /*

Piloted proportional directional valve

- A** = without position transducer
- AE** = as A plus integral electronics
- AES** = as A plus integral digital electronics
- AEG** = as AES plus internal reference generation (1)
- AEZ** = as AES plus internal cycle generator (2)

Communication interfaces (only for digital electronics)

- PS** = Serial (3)
- BC** = CANopen (only AES)
- BP** = PROFIBUS DP (only AES)

Valve size:

1 = 10 **2** = 16 **3** = 25 **6** = 32

Configuration, see section 3:

- 5** = external plus central position, spring centered
- 7** = 3 positions; spring centered

Spool overlapping in central position, see section 3:

- 1** = P, A, B, T positive overlapping (4)
- 3** = P positive overlapping A, B, T negative overlapping

Spool type

- L** = linear
- S** = progressive
- D** = as **S**, but with P-A = Q, P-B = Q/2

Notes:

- (1) For detailed description of AEG integral reference generation, see tab. G120
- (2) For detailed description of AEZ integral cycle generation, see tab. G120
- (3) Serial interface always present, also for -BC and -BP options
- (4) Overlapping = 20% of spool stroke for type **S** and **D**, 10% of spool stroke for type **L**

Synthetic fluids:
WG = water-glycol
PE = phosph. ester

Series number

Coils voltage (only for -A execution):

- see section 6:
- = standard 12 V_{DC} coil
 - 6** = with 6 V_{DC} coil
 - 18** = with 18 V_{DC}

Hydraulic options, see section 4:

- B** = solenoid and integral electronics at side of port B of the main stage;
- D** = internal drain
- E** = external pilot
- G** = pressure reducing valve for piloting

Electronics options for -AE execution, see section 8:

- I** = current reference input (4÷20 mA)
- Q** = enable signal

Electronics options for -AES execution, see section 10:

- Q** = enable signal
- Z** = double power supply, enable fault and monitor (12 pin connector)
- W** = power limitation function (12 pin connector) see section 10.3

Spool size: **3** and **5**, see section 3

DPZO-A* are two stage proportional valves without position transducer, which provide both directional and non compensated flow control according to the electronic reference signal.

They operate in association with electronic drivers, see section 2, which supply the proportional valves with correct current signal to align valve regulation to the reference signal supplied to the electronic driver.

They are available in different executions:

- -A, without position transducer;
- -AE, -AES as -A plus analogue (AE) or digital (AES) integral electronics (4);
- -AEG, as AES plus internal reference generation selected by four on-off (0÷24VDC) inputs available on the main connector (see tab. G120).
- -AEZ, as AES plus internal cycle generation for automatic control of actuator's motion cycle (see tab. G120).

The 4-way spool (2), sliding into a 5-chambers body (1), is piloted in open loop by the proportional pressure reducing valve (3) type DHRZO.

The integral electronics (4) ensures factory presetting, fine functionality plus valve-to-valve interchangeability and simplified wiring and installation.

The electronic main connector (5) is fully interchangeable for -AE and -AES executions.

Standard 7 pin main connector is used for power supply, analog input reference and monitor signals.

12 pin connector is used for -AEG, -AEZ versions and for option /Z (AES).

Following communication interfaces (6), (7) are available for the digital -AES, -AEG and -AEZ executions:

- standard -PS, Serial communication interface for configuration, monitoring and firmware updating through Atos PC software - always present
- optional -BC, CANopen interface (only for -AES)
- optional -BP, PROFIBUS DP interface (only for -AES)

The valves with -BC and -BP interfaces can be integrated into a fieldbus communication network and thus digitally operated by the machine control unit.

The coils are fully plastic encapsulated (insulation class H) and valves have anti-vibration, antishock and weather-proof features.

Surface mounting: ISO 4401 size 10, 16 and 25.

Max flow respectively up to 160 l/min, 340 l/min and 680 l/min with valve differential pressure $\Delta p = 30$ bar, see section 3.

Max pressure: 350 bar.

2 ELECTRONIC DRIVERS FOR DPZO-A*

Valve model	-A						-AE	-AES	-AEG	-AEZ
Drivers model	E-MI-AC-0*F	E-MI-AS-IR	E-BM-AC-0*F	E-BM-AS-PS	E-ME-AC-0*F	E-RP-AC-0*F	E-RI-AE	E-RI-AES	E-RI-AEG	E-RI-AEZ
Data sheet	G010	G020	G025	G030	G035	G100	G110	G115	G120	G120

Note: For power supply and communication connector see section 17 and 19

3 HYDRAULIC CHARACTERISTICS (based on mineral oil ISO VG 46 at 50 °C)

Hydraulic symbols														
Valve model	DPZO-1				DPZO-2				DPZO-3			DPZO-6		
Spool overlapping	1, 3				1, 3				1, 3			1, 3		
Spool type and size	L5	S5	D5	S3	D3	L5	S5	D5	L5	S5	D5	L5	S5	D5
Max flow (1) [l/min]														
at $\Delta p = 10$ bar (P-T)	100	100	100:60	130	130:80	200	180	180:130	390	360	360:220	600	600	600:370
at $\Delta p = 30$ bar (P-T)	160	160	160:100	225	225:135	340	310	310:225	680	620	620:380	1030	1030	1030:640
max permissible flow	180	180	180:110	500	500:300	710	640	640:460	1350	1250	1250:760	1600	1600	1600:100
Pressure limits (2) [bar]	ports P, A, B, X = 350; T = 250 (5 for option /D); Y = 5													
Response time [ms]	< 80				< 100				< 120					
Hysteresis [%]								$\leq 5\%$						
Repeatability								$\pm 1\%$						

Notes:

- For version DPZO-A and DPZO-AE, configuration /B, see the notes at section 14.1
- Above performance data refer to valves coupled with Atos electronic drivers, see section 2.
- In case of long time shutdown of the hydraulic supply to the pilot valve, the driver has to be switched off to avoid its overheating.
- The flow regulated by the directional proportional valves is not pressure compensated, thus it is affected by the load variations. To keep constant the regulated flow under different load conditions, modular pressure compensators are available (see tab. D150).

(1) For different Δp , the max flow is in accordance to the diagrams in section 14.2

(2) Minimum piloting pressure = 30 bar

4 HYDRAULIC OPTIONS

4.1 Option /B Solenoid (for valve configuration *5*) and integral electronics at side of port A. For hydraulic configuration vs. reference signal, see section 14.1

4.2 Pilot and drain configuration -The pilot / drain configuration can be modified as shown in the table E080 section 12.

The valve's standard configuration provides internal pilot and external drain. For different pilot / drain configuration select:

Option /E External pilot (through port X). **Option /D** Internal drain.

Option /G Pressure reducing valve with fixed setting (= 40 bar for DPZO-1 and -2; 100 bar for DPZO-3) installed between pilot valve and main body. It is advisable for valves with internal pilot in case of system pressure higher than 200 bar. This option is standard for DPZO-L*-1.

5 GENERAL NOTES

DPZO-A* proportional valves 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 valve (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).

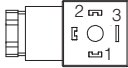
6 OPTIONS FOR -A EXECUTION

6.1 Option /6 6 Vdc coil instead of standard 12 Vdc, to be used in case of power supply 12 Vdc

6.2 Option /18 18 Vdc coil instead of standard 12 Vdc, to be used with electronic drivers not supplied by Atos

7 CONNECTIONS FOR -A EXECUTION

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



8 ANALOG INTEGRAL DRIVERS -AE - OPTIONS

Standard driver execution provides on the 7 pin main connector:

Power supply - 24Vdc must be appropriately stabilized or rectified and filtered; a 2,5 A safety fuse is required in series to the driver power supply. Apply at least a 10000 μ F/40 V capacitance to single phase rectifiers or a 4700 μ F/40 V capacitance to three phase rectifiers

Reference input signal - analog differential input with ± 10 Vdc nominal range (pin D,E), proportional to desired coil current.

Monitor output signal - analog output signal proportional to the actual valve's coil current (1V monitor = 1A coil current)

Following options are available to adapt standard execution to special application requirements:

8.1 Option /I

It provides the 4 \pm 20 mA current reference signal instead of the standard ± 10 Vdc. Monitor output signal is still the standard ± 10 Vdc.

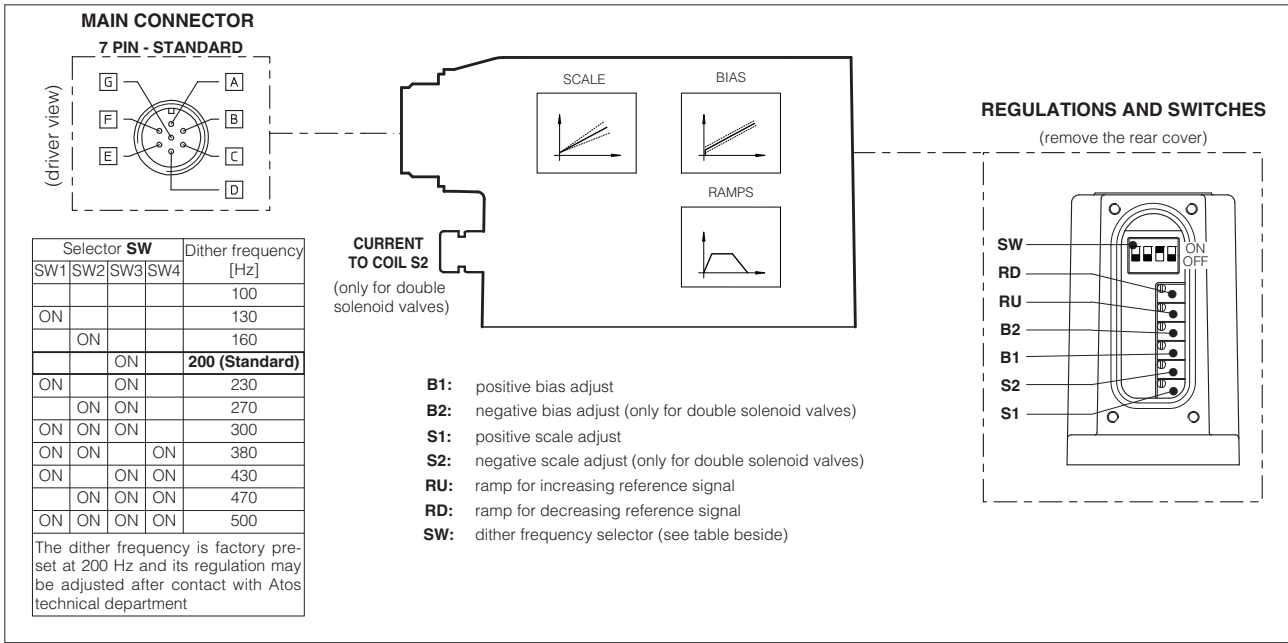
It is normally used in case of long distance between the machine control unit and the valve or where the reference signal can be affected by electrical noise; the valve functioning is disabled in case of reference signal cable breakage.

8.2 Option /Q

It provides the possibility to enable or disable the valve functioning without cutting the power supply (the valve functioning is disabled but the driver current output stage is still active). To enable the driver supply a 24Vdc on the enable input signal.

8.3 Possible combined options: /IQ

9 ANALOG INTEGRAL DRIVERS -AE - MAIN FUNCTIONS AND ELECTRONIC CONNECTIONS



9.1 ELECTRONIC CONNECTIONS - 7 PIN MAIN CONNECTORS

PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
A	V+	Power supply 24 Vdc for solenoid power stage and driver logic	Input - power supply
B	V0	Power supply 0 Vdc for solenoid power stage and driver logic	Gnd - power supply
C (1)	AGND	Ground - signal zero for MONITOR signal	Gnd - analog signal
	ENABLE	Enable (24 Vdc) or disable (0 Vdc) the driver (for /Q option)	Input - on/off signal
D	INPUT+	Reference analog differential input: ±10 Vdc maximum range (4 ÷ 20 mA for /I option) Default setting for single solenoid valves: 0 ÷ +10 Vdc	Input - analog signal
E	INPUT -	Default setting for double solenoid valves: ±10 Vdc	
F	MONITOR	Monitor analog output: ±5 Vdc maximum range; 1 V = 1 A	Output - analog signal
G	EARTH	Internally connected to the driver housing	

Note: (1) with /Q option ENABLE signal replaces AGND on pin C; MONITOR signal is referred to pin B.

A minimum time of 60ms to 160ms have to 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

10 DIGITAL INTEGRAL DRIVERS -AES - OPTIONS

Standard driver execution provides on the 7 pin main connector:

- Power supply** - 24Vdc must be appropriately stabilized or rectified and filtered; a 2.5 A safety fuse is required in series to each driver power supply. Apply at least a 10000 µF/40 V capacitance to single phase rectifiers or a 4700 µF/40 V capacitance to three phase rectifiers.
- Reference input signal** - analog differential input with ±10Vdc nominal range (pin D,E), proportional to desired coil current (4÷20 mA with cable break detection, ±10 mA, ±20 mA or 0÷20 mA software selectable)
- Monitor output signal** - analog output signal proportional to the actual valve's coil current (1V monitor = 1A coil current)

Following options are available to adapt standard execution to special application requirements:

10.1 Option /Q

To enable the driver, supply 24Vdc on pin C referred to pin B: when the enable signal is set to zero the valve status is software selectable, by factory default the valve functioning is disabled (zero current to the solenoid) but the driver current output stage is still active. For the complete list of selectable status, see tab. G115.

10.2 Option /Z

It provides, on the 12 pin main connector, the following additional features:

Logic power supply

Separated 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. This condition allows to realize safety systems in compliance with European Norms EN13849-1 (ex EN954-1).

Enable Input Signal

To enable the driver, supply 24Vdc on pin 3 referred to pin 2: when the enable signal is set to zero the valve status is software selectable, by factory default the valve functioning is disabled (zero current to the solenoid) but the driver current output stage is still active. For the complete list of selectable status, see tab. G115.

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, etc.). Fault presence corresponds to 0 Vdc, normal working corresponds to 24Vdc (pin 11 referred to pin 2): Fault status is not affected by the Enable input signal

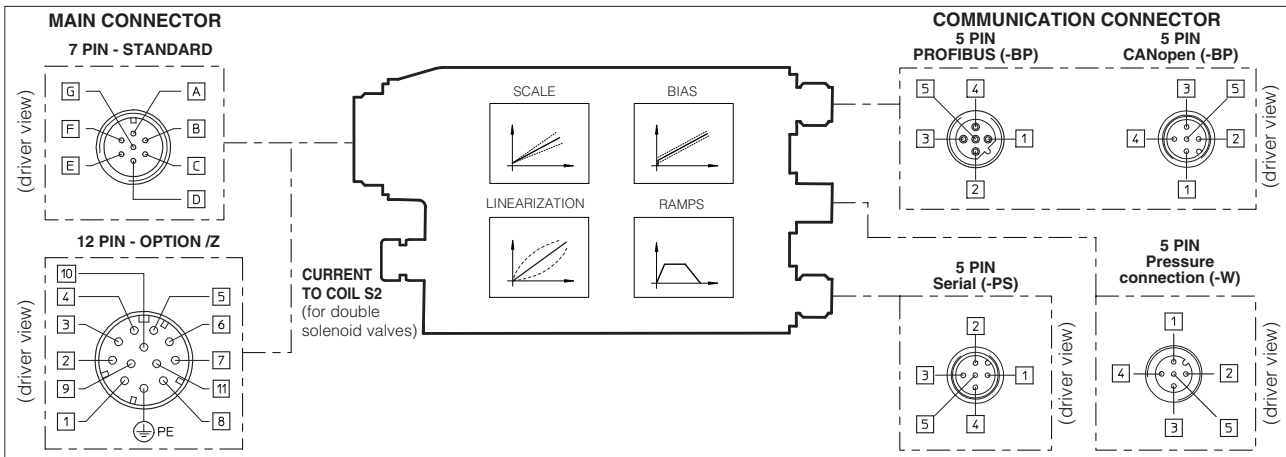
10.3 Option /W - only for valves coupled with pressure compensator type HC-011 or KC-011 (see tab. D150).

It provides, on the 12 pin main connector, the above option /Z features plus the hydraulic power limitation function. The driver receives the flow reference signal by the analog external input INPUT+ and a pressure transducer remotely installed in the hydraulic system, has to be connected to the driver's analog input TR. When the actual requested hydraulic power $p \times Q$ ($TR \times INPUT+$) reaches the max power limit ($p1 \times Q1$), internally set by software, the driver automatically reduces the flow regulation of the valve. The higher is the pressure feedback the lower is the valve's regulated flow:

$$\text{Flow regulation} = \text{Min} \left(\frac{\text{PowerLimit [sw setting]}}{\text{Transducer Pressure [TR]}}; \text{Flow Reference [INPUT+]} \right)$$

For detailed information on hydraulic power limitation, see tab. G115

11 DIGITAL INTEGRAL DRIVERS -AES - MAIN FUNCTIONS AND ELECTRONIC CONNECTIONS



11.1 ELECTRONIC CONNECTIONS - 7 & 12 PIN MAIN CONNECTORS (-AES standard, /Q, /Z, /W options)

Standard 7pin	/Z, /W options 12pin	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
A	1	V+	Power supply 24 Vdc for solenoid power stage (and for driver logic on 7 pin connection)	Input - power supply
B	2	V0	Power supply 0 Vdc for solenoid power stage (and for driver logic on 7 pin connection)	Gnd - power supply
C (option /Q)	3	ENABLE	Enable (24 Vdc) or disable (0 Vdc) the driver	Input - on/off signal
D	4	INPUT+	Reference analog input: ± 10 Vdc ± 20 mA maximum range software selectable Default setting for single solenoid valves: $0 \div +10$ Vdc, differential input Default setting for double solenoid valves: ± 10 Vdc, differential input /Z and /W options: common mode INPUT+ referred to AGND	Input - analog signal
E	-	INPUT -		Input - analog signal
C	5	AGND	Ground - signal zero for MONITOR signal (INPUT+ signal only for /Z and /W options)	Gnd - analog signal
F	6	MONITOR	Monitor analog output: ± 5 Vdc maximum range; Default setting $1V = 1A$	Output - analog signal
-	7	NC	do not connect	
-	8	MONITOR 2	2nd monitor analog output: ± 5 Vdc maximum range (only for /W option)	Output - analog signal
-	9	VL+	Power supply 24 Vdc for driver logic	Input - power supply
-	10	VL0	Power supply 0 Vdc for driver logic	Gnd - power supply
-	11	FAULT	Fault (0 Vdc) or normal working (24 Vdc)	Output - on/off signal
G	PE	EARTH	Internally connected to the driver housing	

Note: A minimum time of 270 to 340 ms have to 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.

11.2 ELECTRONIC CONNECTIONS - 5 PIN COMMUNICATION AND PRESSURE TRANSDUCER CONNECTORS

PIN	-PS Serial		-BC CANopen		-BP PROFIBUS DP		/W option	
	SIGNAL	TECHNICAL SPECIF.	SIGNAL	TECHNICAL SPECIF.	SIGNAL	TECHNICAL SPECIF.	SIGNAL	TECHNICAL SPECIF.
1	NC	do not connect	CAN_SHLD	Shield	+5V	for termination	VT	transducer power supply 24 Vdc
2	NC	do not connect	NC	do not connect	LINE-A	Bus line (high)	TR	transducer signal $0 \div 10$ Vdc
3	RS_GND	Signal zero data line	CAN_GND	Signal zero data line	DGND	Data line and termination Signal zero	AGND	Signal zero for power supply and signal
4	RS_RX	Receiving data line	CAN_H	Bus line (high)	LINE-B	Bus line (low)	NC	do not connect
5	RS_TX	Transmitting data line	CAN_L	Bus line (low)	SHIELD	do not connect	NC	do not connect

12 SOFTWARE TOOLS

The driver configuration and parameters can be easily set with the Atos E-SW programming software, available in three different versions according to the driver's communication execution: E-SW-PS (Serial), E-SW-BC (CANopen) and E-SW-BP (PROFIBUS DP). Programming software E-SW-BC and E-SW-BP, for BC and BP drivers, can be also used to modify the valve's parameterization through the serial communication interface, without disconnecting the valve from the machine's bus line.

For a more detailed description of software interface, PC requirements, adapters, cables and terminators, please refer to technical table G500.

Programming software, must be ordered separately:

E-SW-* (mandatory - first supply) = Dvd including E-SW-* software installer and operator manuals; it allows the registration to Atos digital service

E-SW-*N (optional - next supplies) = as above but not allowing the registration to Atos digital service

On first supply of the E-SW-* software, it is required to apply for the registration in the Atos download area: www.download.atos.com.

Once the registration is completed, the password will be sent by email.

The software remains active for 10 days from the installation date and then it stops until the user inputs his password.

With the password you can also download, in your personal area, the latest releases of the Atos software, manuals, drivers and configuration files.

13 MAIN CHARACTERISTICS OF PROPORTIONAL DIRECTIONAL VALVES

Assembly position	Any position					
Subplate surface finishing	Roughness index, \sqrt{Ra} flatness ratio 0,01/100 (ISO 1101)					
Ambient temperature	$-20^{\circ}\text{C} \div +70^{\circ}\text{C}$ for -A execution; $-20^{\circ}\text{C} \div +60^{\circ}\text{C}$ for -AE, -AES, -AEG and -AEZ executions					
Fluid	Hydraulic oil as per DIN 51524 ... 535 for other fluids see section [I]					
Recommended viscosity	$15 \div 100$ mm ² /s at 40°C (ISO VG 15÷100)					
Fluid contamination class	ISO 18/15 achieved with in line filters of 10 μm and $\beta_{10} \geq 75$ (recommended)					
Fluid temperature	$-20^{\circ}\text{C} \div +60^{\circ}\text{C}$ (standard and /WG seals) $-20^{\circ}\text{C} \div +80^{\circ}\text{C}$ (/PE seals)					
Coil Voltage	DHZO-A*			DKZOR-A*		
	with 12 Vdc coil	with 6 Vdc coil	with 18 Vdc coil	with 12 Vdc coil	with 6 Vdc coil	with 18 Vdc coil
Coil resistance R at 20°C	$3 \div 3,3 \Omega$	$2 \div 2,2 \Omega$	$13 \div 13,4 \Omega$	$3,8 \div 4,1 \Omega$	$2,2 \div 2,4 \Omega$	$12 \div 12,5 \Omega$
Max. solenoid current	2,2 A	2,75 A	1 A	2,6 A	3,25 A	1,2 A
Max. power	30 Watt			35 Watt		
Protection degree (CEI EN-60529)	IP65 for -A execution; IP67 for -AE, -AES, -AEG and -AEZ executions					
Duty factor	Continuous rating (ED=100%)					

14 DIAGRAMS (based on mineral oil ISO VG 46 at 50 °C)

14.1 Regulation diagrams

- DPZO-1:
1 = linear spool L5
2 = differential spool S5, D5
- DPZO-2:
3 = progressive spool S3, D3
4 = progressive spool S5, D5
5 = linear spool L5
- DPZO-3:
6 = linear spool L5
7 = progressive spool S5, D5
- DPZO-6:
8 = linear spool L5
9 = progressive spool S5, D5

Note:

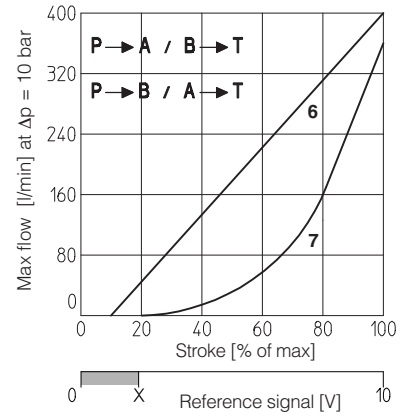
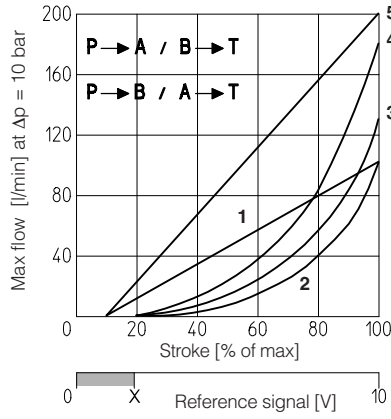
Hydraulic configuration vs reference signal for:
 - double solenoid valves (standard and option /B)

Reference signal $0 \div +10 \text{ V}$ } $P \rightarrow A / B \rightarrow T$
 $12 \div 20 \text{ mA}$

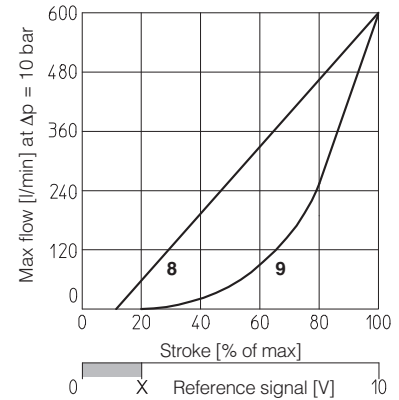
Reference signal $0 \div -10 \text{ V}$ } $P \rightarrow B / A \rightarrow T$
 $4 \div 12 \text{ mA}$

Hydraulic configuration vs reference signal for single solenoid valves:

Reference signal:
 $0 \div +10 \text{ V}$ } $P \rightarrow A / B \rightarrow T$ (standard)
 $4 \div 20 \text{ mA}$ } $P \rightarrow B / A \rightarrow T$ (option /B)



X = Threshold for bias activation depending to the valve type and amplifier type



14.2 Flow /Δp diagram

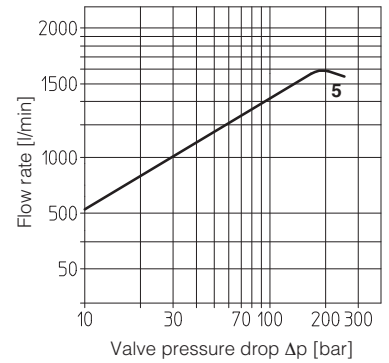
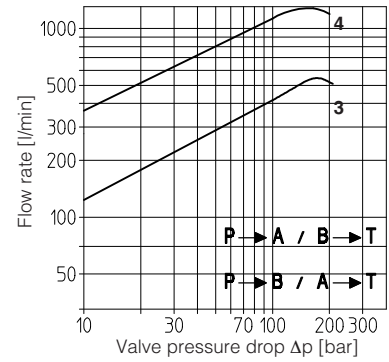
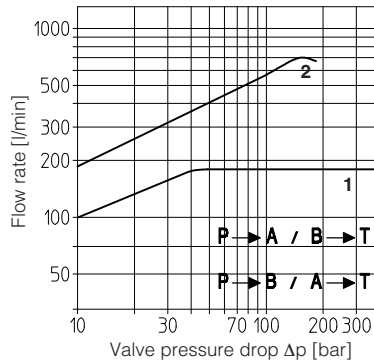
Stated at 100% of valve stroke

DPZO-1:
1 = spool L5, S5, D5

DPZO-2:
2 = spool L5, S5, D5
3 = spool S3, D3

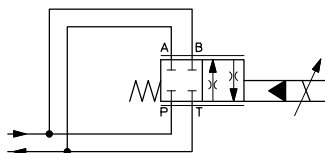
DPZO-3:
4 = spool L5, S5, D5

DPZO-6:
5 = spool L5, S5, D5



14.3 Operation as throttle valve

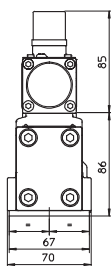
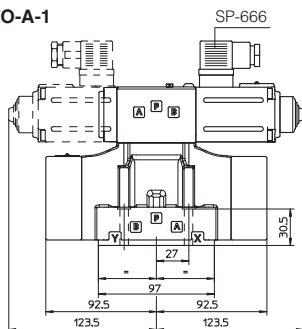
Single solenoid valves (*51) can be used as simple throttle valves:
 $P_{max} = 250 \text{ bar}$
 For this application, the use of valve -T, -TE or -TES (see tab. F172 and F175) is advisable (consult our technical office)



DPZO-*	151-L5	251-L5	351-L5	651-L5
Max flow [l/min]	320	650	1300	2000
Δp [bar]	30	30	30	30

DPZO-A(*)-1 (dotted line = double solenoid version)

DPZO-A-1

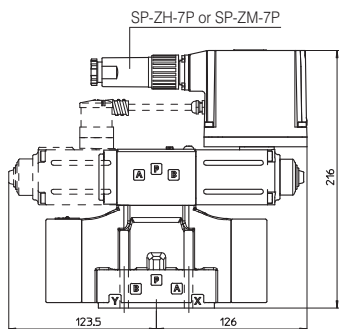


ISO 4401: 2005

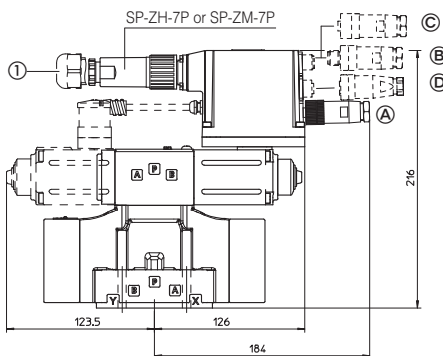
Mounting surface: 4401-05-05-0-05 (see table P005)

Fastening bolts:
4 socket head screws M6x40 class 12.9
Tightening torque = 15 Nm
Seals: 5 OR 2050; 2 OR 108
Diameter of ports A, B, P, T: $\varnothing = 11$ mm;
Diameter of ports X, Y: $\varnothing = 5$ mm;

DPZO-AE-1



DPZO-AES-(AEG, AEZ)-1



Mass [kg]

	A	AE, AES, AEG, AEZ
DPZO-*-15*	7,7	8,1
DPZO-*-17*	8,6	9

-AES EXECUTION

① Dotted line = 12 pin connector SP-ZH-12P for -AES option /Z, -AEG, -AEZ

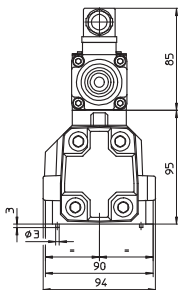
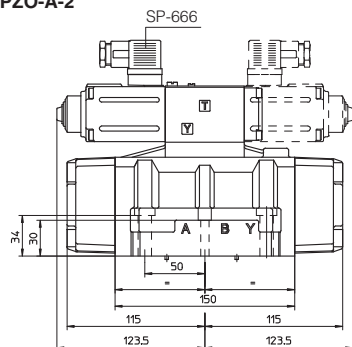
NOTE:

For option /B the proportional solenoid and the electronics (in case of execution -AE and -AES) are at side of port B of the main stage.

- Ⓐ -PS communication interface, SP-ZH-5P connector
- Ⓑ -BP communication interface, SP-ZH-5P/BP connector
- Ⓒ -BC communication interface, SP-ZH-5P connector
- Ⓓ Pressure transducer interface (option /W) port, SP-ZH-5PM connector

DPZO-A(*)-2 (dotted line = double solenoid version)

DPZO-A-2

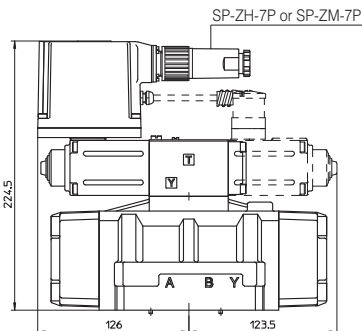


ISO 4401: 2005

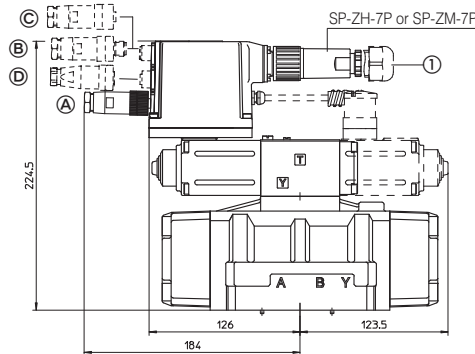
Mounting surface: 4401-07-07-0-05 (see table P005)

Fastening bolts:
4 socket head screws M10x50 class 12.9
Tightening torque = 70 Nm
2 socket head screws M6x40 class 12.9
Tightening torque = 15 Nm
Seals: 4 OR 130; 3 OR 109/70
Diameter of ports A, B, P, T: $\varnothing = 20$ mm;
Diameter of ports X, Y: $\varnothing = 7$ mm;

DPZO-AE-2



DPZO-AES-(AEG, AEZ)-2



Mass [kg]

	A	AE, AES, AEG, AEZ
DPZO-*-25*	11,9	12,3
DPZO-*-27*	12,8	13,2

-AES EXECUTION

① Dotted line = 12 pin connector SP-ZH-12P for -AES option /Z, -AEG, -AEZ

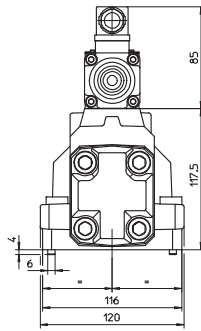
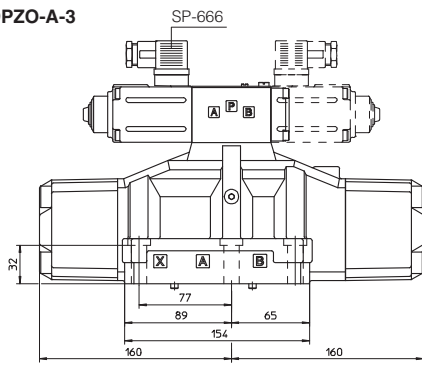
NOTE:

For option /B the proportional solenoid and the electronics (in case of execution -AE and -AES) are at side of port B of the main stage.

- Ⓐ -PS communication interface, SP-ZH-5P connector
- Ⓑ -BP communication interface, SP-ZH-5P/BP connector
- Ⓒ -BC communication interface, SP-ZH-5P connector
- Ⓓ Pressure transducer interface (option /W) port, SP-ZH-5PM connector

DPZO-A(*)-3 (dotted line = double solenoid version)

DPZO-A-3



ISO 4401: 2005

Mounting surface: 4401-08-08-0-05 (see table P005)

Fastening bolts:

6 socket head screws M12x50 class 12.9

Tightening torque = 125 Nm

Seals: 4 OR 4112; 3 OR 3056

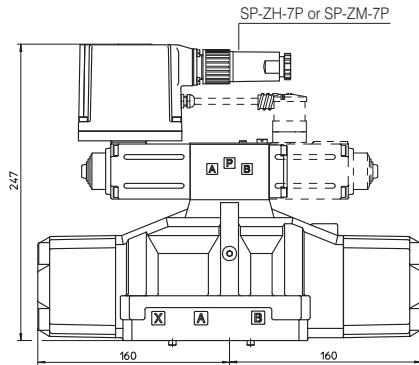
Diameter of ports A, B, P, T: $\varnothing = 24$ mm;

Diameter of ports X, Y: $\varnothing = 7$ mm;

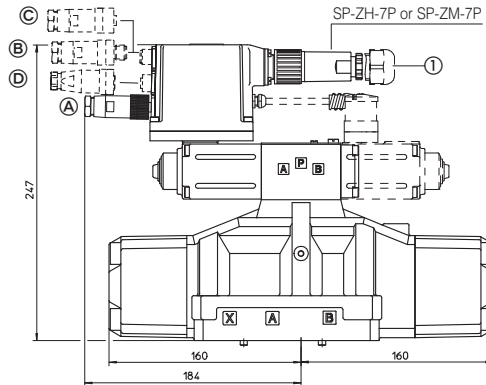
Mass [kg]

	A	AE, AES, AEG, AEZ
DPZO-* -35*	17,1	17,5
DPZO-* -37*	18	18,4

DPZO-AE-3



DPZO-AES (AEG, AEZ)-3



-AES EXECUTION

- ① Dotted line = 12 pin connector SP-ZH-12P for -AES option /Z, -AEG, -AEZ

- Ⓐ -PS communication interface, SP-ZH-5P connector
- Ⓑ -BP communication interface, SP-ZH-5P/BP connector
- Ⓒ -BC communication interface, SP-ZH-5P connector
- Ⓓ Pressure transducer interface (option /W) port, SP-ZH-5PM connector

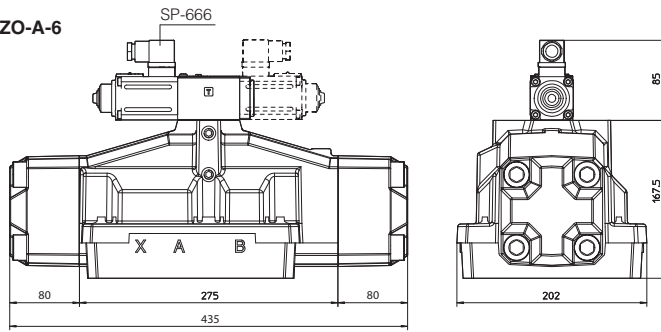
NOTE:

For option /B the proportional solenoid and the electronics (in case of execution -AE and -AES) are at side of port B of the main stage.

17 INSTALLATION DIMENSIONS FOR DPZO-6 [mm]

DPZO-A(*)-6 (dotted line = double solenoid version)

DPZO-A-6



ISO 4401: 2005

Mounting surface: 4401-08-08-0-05 (see table P005)

Fastening bolts:

6 socket head screws M12x50 class 12.9

Tightening torque = 125 Nm

Seals: 4 OR 4112; 3 OR 3056

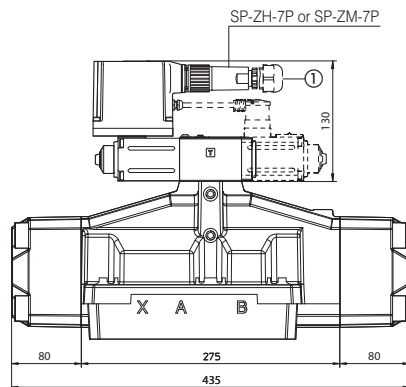
Diameter of ports A, B, P, T: $\varnothing = 24$ mm;

Diameter of ports X, Y: $\varnothing = 7$ mm;

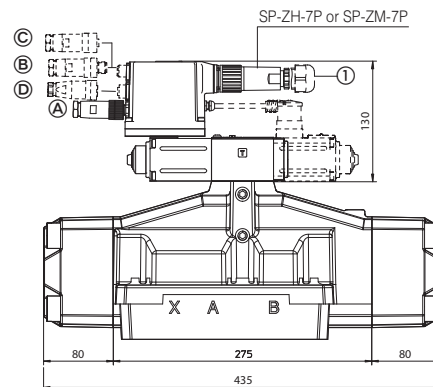
Mass [kg]

	A	AE, AES
DPZO-*35*	17,1	17,5
DPZO-*37*	18	18,4

DPZO-AE-6



DPZO-AES-3



-AES EXECUTION

- ① Dotted line = 12 pin connector SP-ZH-12P for -AES option /Z, -AEG, -AEZ

- Ⓐ -PS communication interface, SP-ZH-5P connector
- Ⓑ -BP communication interface, SP-ZH-5P/BP connector
- Ⓒ -BC communication interface, SP-ZH-5P connector
- Ⓓ Pressure transducer interface (option /W) port, SP-ZH-5PM connector

NOTE:

For option /B the proportional solenoid and the electronics (in case of execution -AE and -AES) are at side of port B of the main stage.

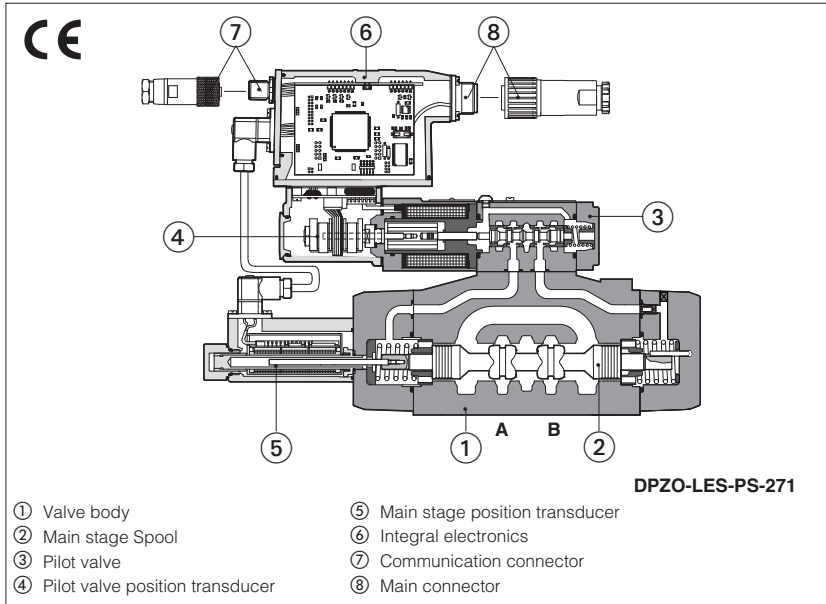
18 MODEL CODES OF POWER SUPPLY AND COMMUNICATION CONNECTORS (to be ordered separately)

VALVE VERSION	-A	-AE, -AES		-AES/Z -AEG	-Serial (-PS) or CANopen (-BC)	PROFIBUS DP (-BP)
CONNECTOR CODE	SP-666	SP-ZH-7P	SP-ZM-7P	SP-ZH-12P	SP-ZH-5P	SP-ZH-5P/BP
PROTECTION DEGREE	IP65	IP67	IP67	IP67	IP67	IP67
DATA SHEET	K500	G110, G115, K500			G115, K500	

connectors supplied with the valve

Proportional directional valves type DPZO-L*

high performance, two stage, with two position transducers, ISO 4401 sizes 10, 16 and 25



1 MODEL CODE

DPZO -LES -PS - 2 7 1 - L 5 / * / ** / *

Piloted proportional directional valve L = with two integral position transducers LE = as L plus integral analog electronics LES = as L plus integral digital electronics			Synthetic fluids WG = water-glycol PE = phosphate ester Series number
Communication interfaces (only for LES) PS = Serial BC = CANopen BP = PROFIBUS DP			Hydraulic options , see section 4: B = solenoid, integral electronics and position transducer at side of port B of the main stage G = pressure reducing valve for piloting - standard for DPZO-L*-1 E = external pilot (through port X) D = internal drain
Valve size: 1 = 10; 2 = 16; 3 = 25; 6 = 32			Electronic options for -LE execution see section 17: F = fault signal I = current reference input and monitor (4+20 mA) Q = enable signal Z = enable, fault and monitor signal (12 pin connector)
Configuration, see section 2 5 = external plus central position, spring centered 6 = 2 external position, spring offset (only for spool overlapping 0 and type L) 7 = 3 position, spring centered			Electronic options for -LES execution see section 17: I = current reference input and monitor (4+20 mA) Z = double power supply, enable, fault and monitor signals (12 pin connector)
Spool overlapping in central position, see section 3 0 = zero overlapping (only for spool type L, DL and T) (1) 1 = P, A, B, T with positive overlapping (2) 3 = P positive overlapping (2); A, B, T, negative overlapping			Special options for -LES execution see section 17: SF = additional closed loop force control, with two remote pressure transducers SL = additional closed loop force control with one remote load cell SP = additional closed loop pressure control with one remote pressure transducer C = current feedback interface for transducer(s) only for options /SF, /SL, /SP
Spool type (regulating characteristics): L = linear; S = progressive; D = differential-progressive (as S , but with P-A = Q, P-B = Q/2) DL = differential-linear (as L , but with P-A = Q, P-B = Q/2) Q = linear spool, for alternate P/Q controls (3) T = non linear V = differential-progressive, for alternate P/Q controls (3)			
Spool size: 3, 5, 9 see section 3			

Notes:

- (1) For zero overlapping spool **0L3, 0L5, 0DL5, 0T5**, the valve offset position (with switch-off power supply) is 1 ÷ 6% P-B/A-T
- (2) Overlapping = 20% of spool stroke for type **S, D** and **Q**; 10% of spool stroke for type **L** and **DL**
- (3) The spool type **Q** and **V** are used in combination with option /SP of digital integral drivers, see section 13.1 and G212

2 ELECTRONIC DRIVERS

Valve model	-L	-LE	-LES	-LES / SF, SL, SP
Drivers model	E-ME-L	E-RI-LE	E-RI-LES	E-RI-LES /SF, /SL, /SP
Data sheet	G150	G200	G210	G212

Note: For power supply and communication connector see section 16

DPZO-L* are two stage proportional valves with double position transducer which provide both directional and non compensated flow control according to electronic reference signal.

They operate in association with electronic drivers, see section 2, which supply the proportional valves with proper current to align valve regulation to the reference signal supplied to the electronic driver.

They are high performance valves particularly used in closed loop positioning or speed controls with high dynamic requirements.

They are available in different executions:

- -L, with two position transducers ④, ⑤;
 - -LE, -LES as -L plus analog (LE) or digital (LES) integral electronics ⑥.
- The 4-way spool ②, sliding into a 5-chambers body ①, is piloted by the high performance proportional directional valve ③ type DLHZO (see tab. F180) provided of high precision sleeve and LVDT position transducer ④ for maximum regulating accuracy and dynamic response. It is controlled in double closed loop position by means of the LVDT position transducers ④ and ⑤.

The integral electronics ⑥ ensures factory presetting, fine functionality plus valve-to-valve interchangeability and simplified wiring and installation. The electronic main connector ⑧ is fully interchangeable for -LE and -LES executions.

Standard 7 pin main connector is used for power supply, analog input reference and monitor signals.

12 pin connector is used for options /Z and /S*.

The special /S* options add a closed loop control of pressure (/SP) or force (/SF and /SL) to the basic closed loop spool position one.

Following communication interfaces ⑦ are available for the digital -LES execution:

- -PS, Serial communication interface for configuration, monitoring and firmware updating through Atos PC software
 - -BC, CANopen interface
 - -BP, PROFIBUS DP interface
- The valves with -BC and -BP interfaces can be integrated into a fieldbus communication network and thus digitally operated by the machine control unit.

The coils are fully plastic encapsulated (insulation class H) and the valves have antivibration, antishock and weather-proof features.

Mounting surface: ISO 4401 sizes 10, 16 and 25.

Max flow respectively up to 160 l/min, 340 l/min and 680 l/min with valve differential pressure $\Delta p = 30$ bar, see table 2.

Max pressure: 350 bar.

3 HYDRAULIC CHARACTERISTICS OF STANDARD SPOOL (based on mineral oil ISO VG 46 at 50 °C) (3)

Standard spools - hydraulic symbols																			
Valve model	DPZO-L*-1				DPZO-L*-2				DPZO-L*-3				DPZO-L*-6						
Spool overlapping	0, 1, 3	1, 3	0, 1, 3	0, 1, 3	1, 3	0, 1, 3	1, 3	0, 1, 3	0, 1, 3	1, 3	0, 1, 3	0, 1, 3	0, 1, 3	1, 3	3				
Spool type and size	L5	S5	D5	DL5	L3	S3	D3	L5	S5	D5	DL5	L5	S5	D5					
Max flow (1):	[l/min]																		
at $\Delta p = 10$ bar	100	100:60	130	130:80	200	180	180:130	200:145	390	360	360:220	390:240	640	640	640:400				
at $\Delta p = 30$ bar	160	160:100	225	225:130	340	310	310:225	340:250	680	620	620:380	680:410	1100	1100	1100:690				
max permissible flow	180	180:110	550	550:300	760	640	640:460	680:500	1450	1350	1350:820	1450:880	1600	1600	1600:1000				
Specific spools - hydraulic symbols																			
Valve model	DPZO-1			DPZO-2				DPZO-3											
Spool overlapping	1, 3	3		1, 3		3		0	1, 3		3								
Spool type and size	D9	Q5		V9		D9		L9		Q5		V9		T5	D9	Q5		V9	
Max flow (1):	[l/min]																		
at $\Delta p = 10$ bar	100:60		100		200:150		200		150		390:240		390						
at $\Delta p = 30$ bar	160:100		160		340:250		340		250		680:410		680						
max permissible flow	180:110		180		680:500		680		550		1450:880		1450						
Pressure limits (2)	[bar]																		
ports P, A, B, X = 350; T = 250 (10 for option /D); Y = 10																			
Response time [ms]	spool overlapping 0		< 25				< 25				< 30								
	spool overlapping 1-3		< 50				< 70				< 75								
Hysteresis [%]	$\leq 0,1\%$																		
Repeatability	$\pm 0,1\%$																		
Thermal drift	zero point displacement < 1% at $\Delta T = 40^\circ C$																		

Notes:

- Above performance data refer to valves coupled with Atos electronic drivers, see section 2.
 - In case of long interruption of the hydraulic supply to the pilot valve, the driver has to be switched off to avoid its overheating.
- (1) For different Δp , the max flow is in accordance to the diagrams in section 13.2
(2) Minimum piloting pressure = 25 bar

4 HYDRAULIC OPTIONS

4.1 Option /B Solenoid, integral electronics and position transducer at side of port B of the main stage.

For hydraulic configuration vs reference signal, see section 13.1

4.2 Option /G Pressure reducing valve with fixed setting (= 40 bar for DPZO-1 and -2; 100 bar for DPZO-3) installed between pilot valve and main body. It is advisable for valves with internal pilot in case of system pressure higher than 200 bar. This option is standard for DPZO-L*-1.

4.3 Pilot and drain configuration -The pilot / drain configuration can be modified as shown in the table E080 section 12.

The valve's standard configuration provides internal pilot and external drain. For different pilot / drain configuration select:

Option /E External pilot (through port X). **Option /D** Internal drain.

5 GENERAL NOTES

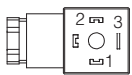
DPZO-L* proportional valves are CE marked according to the applicable Directives (e.g. Immunity/Emission EMC Directive and Low Voltage Directive).

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.

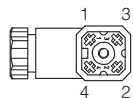
The electrical signals of the valve (e.g. monitor signals) must not be directly used to activate safety functions, like to switch-ON/OFF the machine's safety components, as prescribed by the European standards (Safety requirements of fluid technology systems and components-hydraulics, EN-982).

6 CONNECTIONS FOR -L EXECUTION

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



POSITION TRANSDUCER CONNECTOR (pilot and main stage)	
PIN	Signal description
1	OUTPUT SIGNAL
2	SUPPLY -15 V _{DC}
3	SUPPLY +15 V _{DC}
4	GND



7 ANALOG INTEGRAL DRIVERS -LE - OPTIONS

Standard driver execution provides on the 7 pin main connector:

Power supply - 24V_{DC} must be appropriately stabilized or rectified and filtered; a 2,5 A safety fuse is required in series to the driver power supply. Apply at least a 10000 $\mu F/40$ V capacitance to single phase rectifiers or a 4700 $\mu F/40$ V capacitance to three phase rectifiers

Reference input signal - analog differential input with ± 10 V_{DC} nominal range (pin D, E), proportional to desired valve spool position

Monitor output signal - analog output signal proportional to the actual valve's spool position with ± 10 V_{DC} nominal range

Following options are available to adapt standard execution to special application requirements:

7.1 Option /F

It provides a Fault output signal in place of the Monitor output signal, to indicate fault conditions of the driver (cable interruption of spool transducers or reference signal - for /I option): Fault presence corresponds to 0 V_{DC}, normal working corresponds to 24 V_{DC}.

7.2 Option /I

It provides the 4 \pm 20 mA current reference and monitor signals instead of the standard ± 10 V_{DC}

It 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.

7.3 Option /Q

It provides the possibility to enable or disable the valve functioning without cutting the power supply (the valve functioning is disabled but the driver current output stage is still active). To enable the driver supply a 24V_{DC} on the enable input signal.

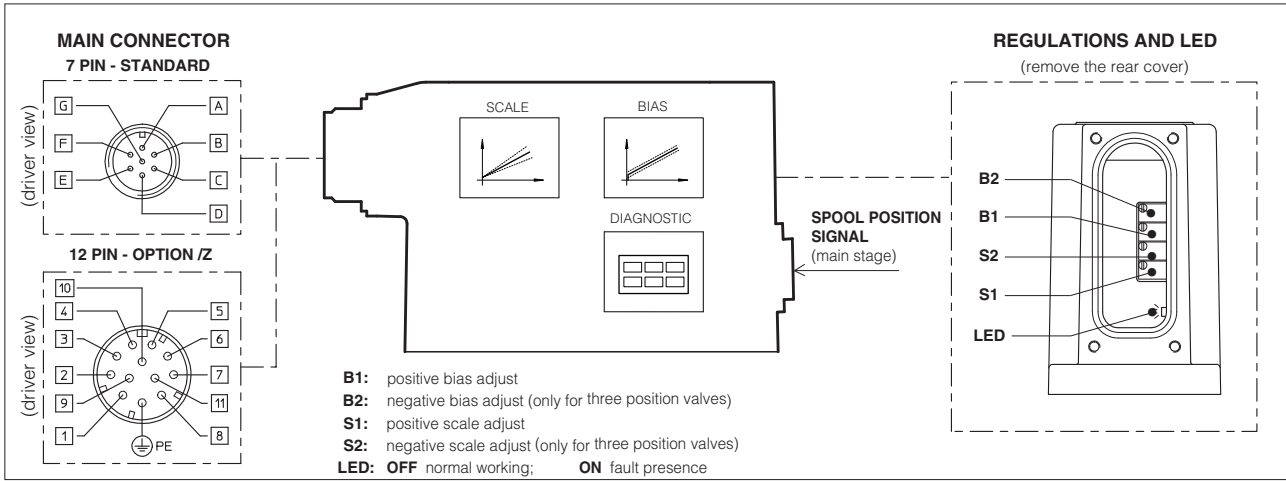
7.4 Option /Z

This option includes /F and /Q features, plus the Monitor output signal.

When the driver is disabled (0 V_{DC} on Enable signal) Fault output is forced to 0.

7.5 Possible combined options: /FI and /IZ

8 ANALOG INTEGRAL DRIVERS -LE - MAIN FUNCTIONS AND ELECTRONIC CONNECTIONS



8.1 ELECTRONIC CONNECTIONS - 7 & 12 PIN MAIN CONNECTORS

Standard 7pin	/Z option 12pin	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
A	1	V+	Power supply 24 Vdc for solenoid power stage and driver logic	Input - power supply
B	2	V0	Power supply 0 Vdc for solenoid power stage and driver logic	Gnd - power supply
C ⁽¹⁾	7	AGND	Ground - signal zero for MONITOR signal (for standard, /Z option)	Gnd - analog signal
	3	ENABLE	Enable (24 Vdc) or disable (0 Vdc) the driver (for /Q and /Z options)	Input - on/off signal
D	4	INPUT+	Reference analog differential input: ± 10 Vdc maximum range (4 \div 20 mA for /I option)	Input - analog signal
E	5	INPUT -	For two position valves the reference input is 0 \div +10 Vdc (4 \div 20 mA for /I option) For three position valves the reference input is ± 10 Vdc (4 \div 20 mA for /I option)	
F ⁽²⁾	6	MONITOR	Monitor analog output: ± 10 Vdc maximum range; (4 \div 20 mA for /I option)	Output - analog signal
	11	FAULT	Fault (0V) or normal working (24V) (for /F and /Z option)	Output - on/off signal
-	8	R_ENABLE	Repeat Enable - output repetition of Enable input	Output - on/off signal
-	9	NC	do not connect	Output - on/off signal
-	10	NC	do not connect	Output - on/off signal
G	PE	EARTH	Internally connected to the driver housing	

Notes:

(1) with /Q option ENABLE signal replaces AGND on pin C; MONITOR signal is referred to pin B

(2) with /F option FAULT signal replaces MONITOR on pin F.

- A minimum time of 50ms to 100ms 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.

9 DIGITAL INTEGRAL DRIVERS -LES - OPTIONS

Standard driver execution provides on the 7 pin main connector:

Power supply - 24Vdc must be appropriately stabilized or rectified and filtered; a 2,5 A safety fuse is required in series to each driver power supply
Apply at least a 10000 μ F/40 V capacitance to single phase rectifiers or a 4700 μ F/40 V capacitance to three phase rectifiers

Reference input signal - analog differential input with ± 10 Vdc nominal range (pin D,E), proportional to desired valve spool position

Monitor output signal - analog output signal proportional to the actual valve's spool position with ± 10 Vdc nominal range

Following options are available to adapt standard execution special to application requirements:

9.1 Option /I

It provides 4 \div 20 mA current reference and monitor signals instead of the standard ± 10 V.

It 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.

9.2 Option /Z

It provides, on the 12 pin main connector, the following additional features:

Logic power supply

Separated 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. This condition allows to realize safety systems in compliance with European Norms EN13849-1 (ex EN954-1).

Enable Input Signal

To enable the driver, supply 24Vdc on pin 3 referred to pin 2: when the Enable signal is set to zero the valve functioning is disabled (zero current to the solenoid) but the driver current output stage is still active.

Fault Output Signal

Fault output signal indicates fault conditions of the driver (solenoid short circuits/not connected, reference signal cable broken for 4 \div 20mA input, etc.). Fault presence corresponds to 0 Vdc, normal working corresponds to 24Vdc (pin 11 referred to pin 2): Fault status is not affected by the Enable input signal

9.3 Options /SP, /SF and /SL

These options add the closed loop control of pressure (/SP) or force (/SF and /SL) to the basic functions of proportional directional valves: a dedicated software alternates pressure (force) and valve's spool position controls depending on the actual hydraulic system conditions.

A dedicated connector is available for the additional transducers that are required to be interfaced to the valve's driver (1 pressure transducer for /SP, 2 pressure transducers for /SF or 1 load cell for /SL).

Main 12 pin connector is the same as /Z option plus two analog signals specific for the pressure (force) control: one for reference (pin 7) and one for monitor (pin 8).

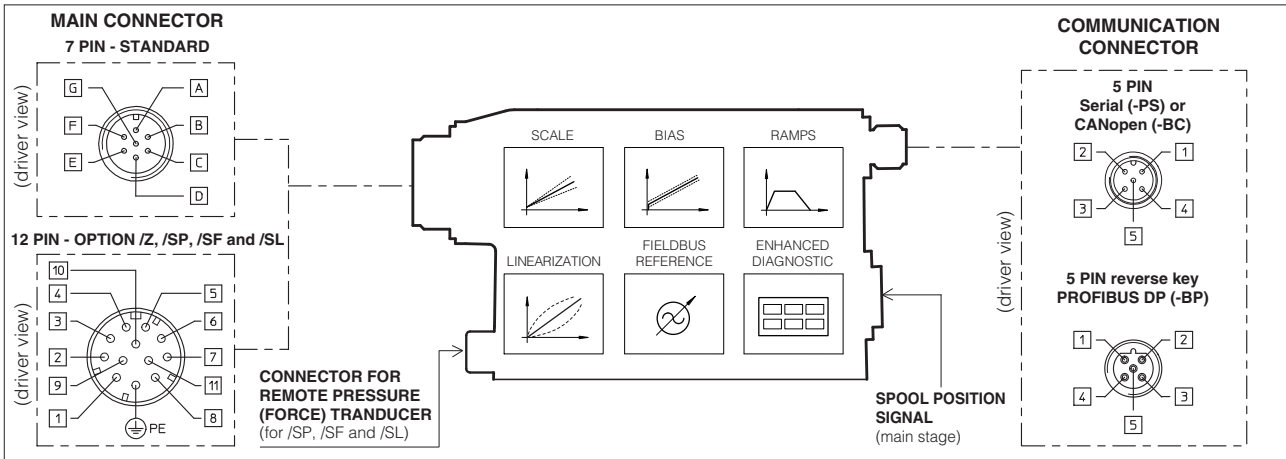
For further details please refer to the driver technical table **G212**.

9.4 Options /C

Options /CSP, /CSF and /CSL are available to connect pressure (force) transducers with 4 \div 20mA current output signal.

9.5 Possible combined options: /ISP, /ISF, /ISL, /ICSP, /ICSF, /ICSL, /ICISP, /ICISF, /ICISL and /IZ

10 DIGITAL INTEGRAL DRIVERS -LES - MAIN FUNCTIONS AND ELECTRONIC CONNECTIONS



10.1 ELECTRONIC CONNECTIONS - 7 & 12 PIN MAIN CONNECTORS

Standard 7pin	/Z option 12pin	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
A	1	V+	Power supply 24 Vdc for solenoid power stage (and for driver logic on 7 pin connection)	Input - power supply
B	2	V0	Power supply 0 Vdc for solenoid power stage (and for driver logic on 7 pin connection)	Gnd - power supply
-	3	ENABLE	Enable (24 Vdc) or disable (0 Vdc) the driver	Input - on/off signal
D	4	INPUT+	Reference analog input: ± 10 Vdc maximum range (4 \div 20 mA for /I option) For two position valves the reference input is 0 \div +10 Vdc (4 \div 20 mA for /I option) For three position valves the reference input is ± 10 Vdc (4 \div 20 mA for /I option) standard: differential input; /Z option: common mode INPUT+ referred to AGND	Input - analog signal
E	-	INPUT -		
C	5	AGND	Ground - signal zero for MONITOR signal signal zero for INPUT+ signal (only for /Z option)	Gnd - analog signal
F	6	MONITOR	Monitor analog output: ± 10 Vdc maximum range; (4 \div 20 mA for /I option)	Output - analog signal
-	7	NC	do not connect (pressure/force input for /SP, /SF and /SL options, see 9.3)	
-	8	NC	do not connect (pressure/force monitor for /SP, /SF and /SL options, see 9.3)	
-	9	VL+	Power supply 24 Vdc for driver logic	Input - power supply
-	10	VL0	Power supply 0 Vdc for driver logic	Gnd - power supply
-	11	FAULT	Fault (0V) or normal working (24V)	Output - on/off signal
G	PE	EARTH	Internally connected to the driver housing	

Note: 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.

10.2 ELECTRONIC CONNECTIONS - 5 PIN COMMUNICATION CONNECTORS

PIN	-PS Serial		-BC CANopen		-BP PROFIBUS DP	
	SIGNAL	TECHNICAL SPECIFICATION	SIGNAL	TECHNICAL SPECIFICATION	SIGNAL	TECHNICAL SPECIFICATION
1	NC	do not connect	CAN_SHLD	Shield	+5V	for termination
2	NC	do not connect	NC	do not connect	LINE-A	Bus line (high)
3	RS_GND	Signal zero data line	CAN_GND	Signal zero data line	DGND	data line and termination Signal zero
4	RS_RX	Valves receiving data line	CAN_H	Bus line (high)	LINE-B	Bus line (low)
5	RS_TX	Valves transmitting data line	CAN_L	Bus line (low)	SHIELD	

11 SOFTWARE TOOLS

The driver configuration and parameters can be easily set with the Atos E-SW programming software, available in three different versions according to the driver's communication execution: E-SW-PS (Serial), E-SW-BC (CANopen) and E-SW-BP (PROFIBUS DP).

For a more detailed description of software interface, PC requirements, adapters, cables and terminators, please refer to technical table G500.

Programming software, must be ordered separately:

E-SW-* (mandatory - first supply) = Dvd including E-SW-* software installer and operator manuals; it allows the registration to Atos digital service

E-SW-*N (optional - next supplies) = as above but not allowing the registration to Atos digital service

On first supply of the E-SW-* software, it is required to apply for the registration in the Atos download area: www.download.atos.com.

Once the registration is completed, the password will be sent by email.

The software remains active for 10 days from the installation date and then it stops until the user inputs his password.

With the password you can also download, in your personal area, the latest releases of the Atos software, manuals, drivers and configuration files.

12 MAIN CHARACTERISTICS OF PROPORTIONAL DIRECTIONAL VALVES

Assembly position	Any position
Subplate surface finishing	Roughness index, \sqrt{Ra} flatness ratio 0,01/100 (ISO 1101)
Ambient temperature	-20°C \div +70°C for -L execution; -20°C \div +60°C for -LE and LES executions
Fluid	Hydraulic oil as per DIN 51524 ... 535 for other fluids see section I
Recommended viscosity	15 \div 100 mm ² /s at 40°C (ISO VG 15 \div 100)
Fluid contamination class	ISO 18/15 achieved with in line filters of 10 μ m and $\beta_{10} \geq 75$ (recommended)
Fluid temperature	-20°C +60°C (standard and /WG seals) -20°C +80°C (/PE seals)
Coil resistance R at 20°C	3 \div 3,3 Ω
Max. solenoid current	2,6 A
Max. power	35 Watt
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 (CEI EN-60529)	IP65 for -L execution; IP67 for -LE and -LES executions
Duty factor	Continuous rating (ED=100%)

13 DIAGRAMS (based on mineral oil ISO VG 46 at 50 °C)

13.1 Regulation diagrams

DPZO-1:

- 1 = 0L5, 0DL5
- 2 = 1L5, 1DL5, 3L5, 3DL5
- 3 = 1S5, 1D5, 3S5, 3D5

DPZO-2:

- 4 = 1L5, 3L5
- 5 = 1S5, 1D5, 1DL5, 3S5, 3D5, 3DL5
- 6 = 1L3, 3L3
- 7 = 1S3, 1D3, 3S3, 3D3
- 8 = 0L5, 0DL5
- 9 = 0L3

DPZO-3:

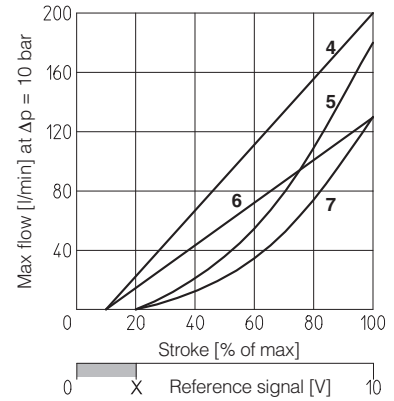
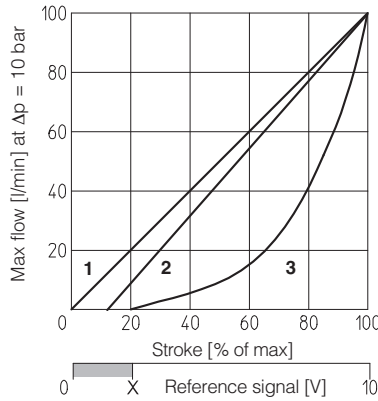
- 10 = 0L5, 0DL5
- 11 = 1L5, 1DL5, 3L5, 3DL5
- 12 = 1S5, 1D5, 3S5, 3D5

DPZO-6:

- 13 = 0L5, 0DL5
- 14 = 1L5, 3L5
- 15 = 1S5, 1D5, 3S5, 3D5

16 = Not linear spool T5 (only for DPZO-2)

The spool type T5 is specific for closed loop position controls and fine low flow metering in the range from 0 to 40% of max spool stroke.

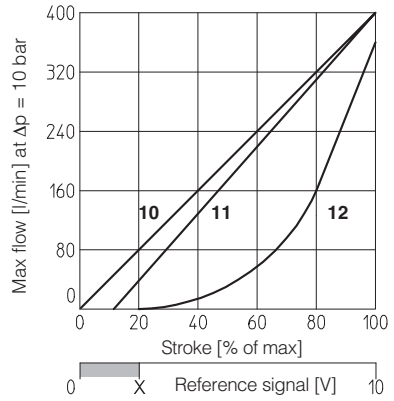
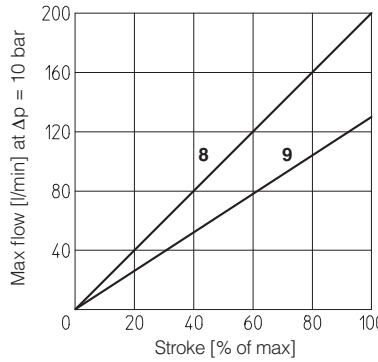


X = Threshold for bias activation depending to the valve type and amplifier type

Note:

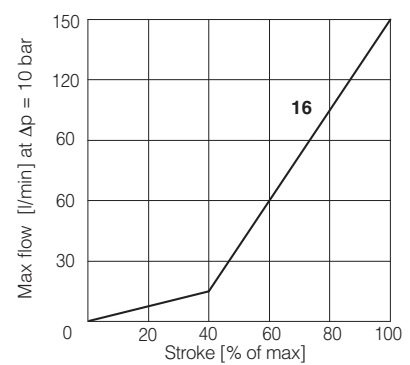
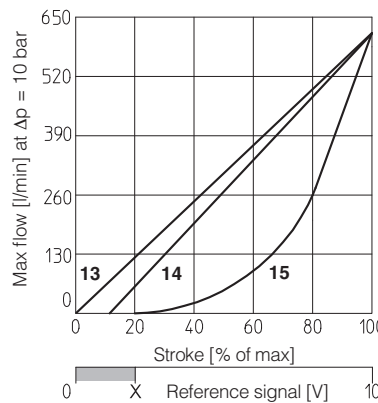
Hydraulic configuration vs. reference signal for configurations 60, 70, 71 and 73 (standard and option /B)

- Reference signal $0 \div +10 \text{ V}$ } P → A / B → T
- $12 \div 20 \text{ mA}$ }
- Reference signal $0 \div -10 \text{ V}$ } P → B / A → T
- $4 \div 12 \text{ mA}$ }



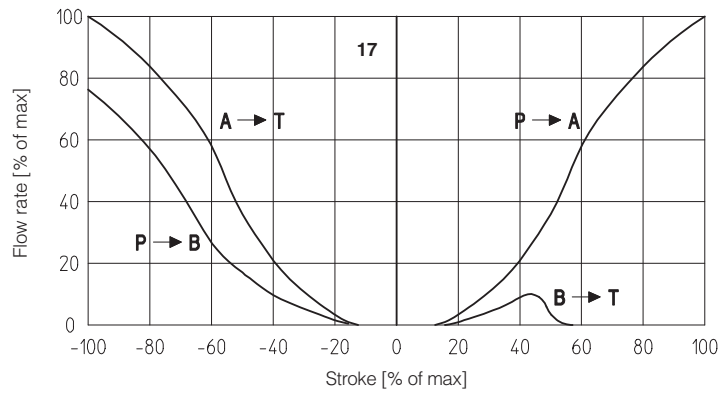
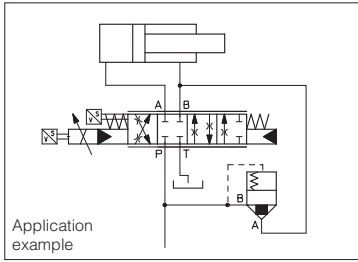
Hydraulic configuration vs. reference signal for configurations 51 and 53 (standard and option /B)

- Reference signal $0 \div +10 \text{ V}$ } P → A / B → T (standard)
- $12 \div 20 \text{ mA}$ } P → B / A → T (option /B)



17 = differential - regenerative spool D9

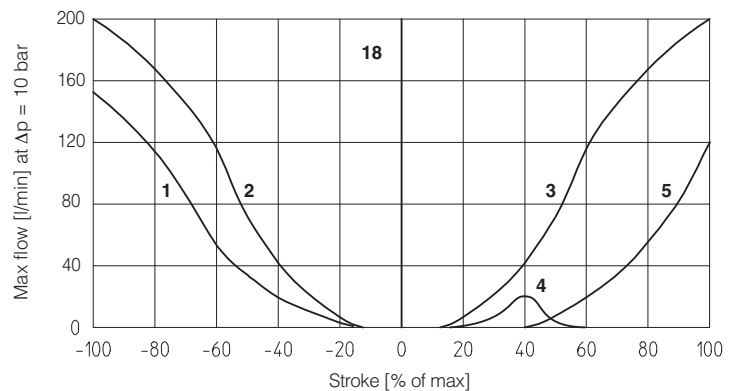
D9 spool type with a fourth position specific to regenerative circuit, performed by means of an additional external check valve.



18 = linear - internal regenerative spool L9 (only for DPZO-2)

L9 spool type with a fourth position specific to perform a regenerative circuit internal to the valve.

- 1 = P - B
- 2 = A - T
- 3 = P - A
- 4 = B - T
- 5 = P - B (regenerative)

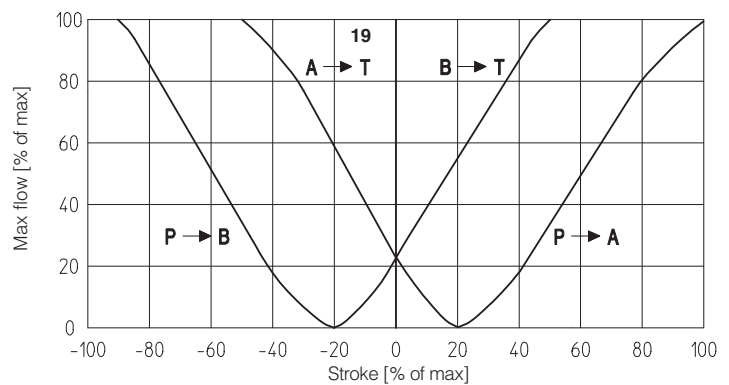


19 = linear spool Q5

Q5 spool type is specific for alternate P/Q controls in combination with /SP option of digital integral drivers, see tab. G212

It allows to control the pressure in A port or B port and it provides a safety central position (A-T/B-T) to depressurize the actuator chambers.

The strong meter-in characteristic makes the spool suitable for both pressure control and motion regulations in several applications.

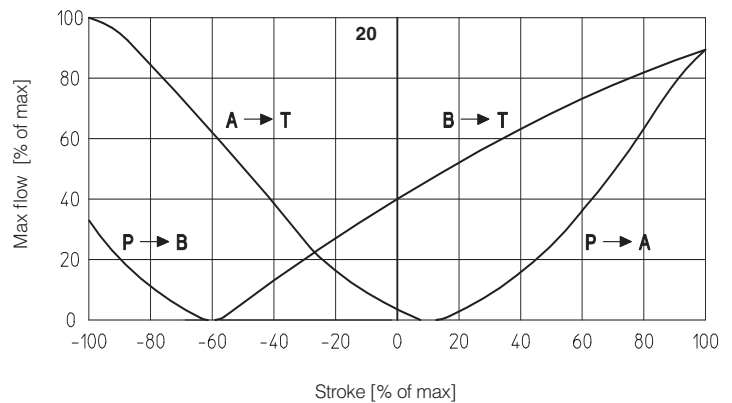


20 = differential - progressive spool V9

V9 spool type is specific for alternate P/Q controls in combination with /SP option of digital integral drivers, see tab. G212

This spool is specially designed to manage the whole injection cycle in plastic machinery, thanks to the following specific features:

- strong meter-in characteristic to allow the pressure control in A port during the holding pressure (P-A) and the plasticizing (A-T) phases
- safety central position (A-T/B-T) to depressurize the actuator chambers
- large A-T and B-T flow capability, required during the plasticizing phase, to discharge big volumes from high differential injection cylinders with low pressure drops and permitting the contemporary oil suction from tank



13.2 Operating diagrams

Flow / Δp diagram

stated at 100% of spool stroke

DPZO-1:

1 = spools L5, S5, D5, DL5, D9, V9

DPZO-2:

2 = spools L5, S5, D5, DL5, D9, L9, V9

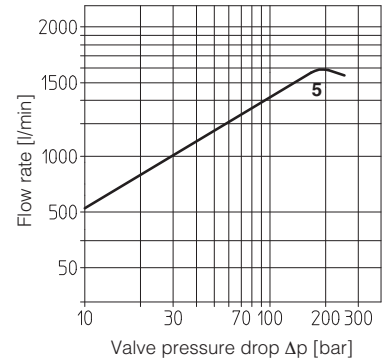
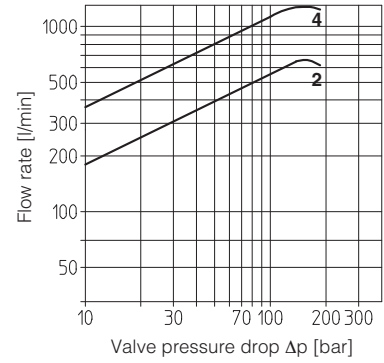
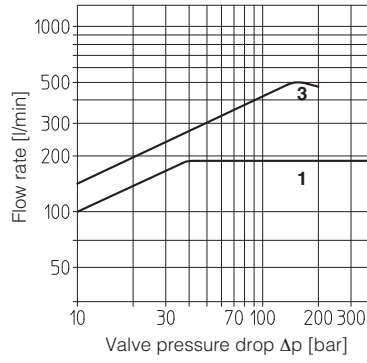
3 = spool L3, S3, D3, T5

DPZO-3:

4 = spools L5, S5, D5, DL5, D9, V9

DPZO-6:

5 = all spools



13.3 Bode diagrams

Stated at nominal hydraulic conditions.

DPZO-1:

1 = 160 and 170 ± 100%

2 = 160 and 170 ± 5%

DPZO-2:

3 = 260 and 270 ± 100%

4 = 260 and 270 ± 5%

DPZO-3:

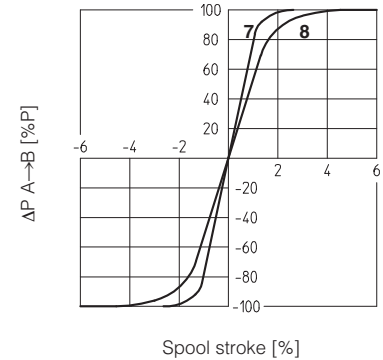
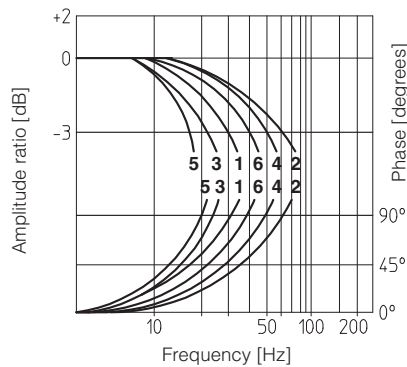
5 = 360 and 370 ± 100%

6 = 360 and 370 ± 5%

13.4 Pressure gain

7 = for DPZO-L(*)-1 *60 and *70

8 = for DPZO-L(*)-2 and DPZO-L(*)-3 *60 and *70



13.5 Dynamic response

The response times in section 2 have to be considered as average values.

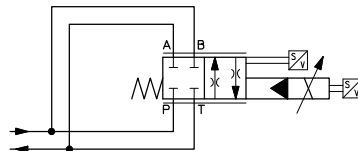
For the valves with digital electronics the dynamics performances can be optimized by setting the internal software parameters.

13.6 Operation as throttle valve

Single solenoid valves (*51) can be

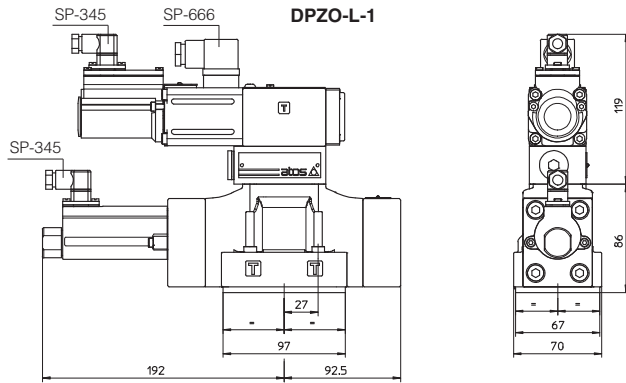
used as simple throttle valves:

Pmax = 250 bar



DPZO-*	151-L5	251-L5	351-L5
Max flow [l/min]	320	650	1300
Δp [bar]	30	30	30

DPZO-L(*)-1



ISO 4401: 2005

Mounting surface: 4401-05-05-0-05 (see table P005)

Fastening bolts:

4 socket head screws M6x40 class 12.9

Tightening torque = 15 Nm

Seals: 5 OR 2050; 2 OR 108

Diameter of ports A, B, P, T: $\varnothing = 11$ mm;

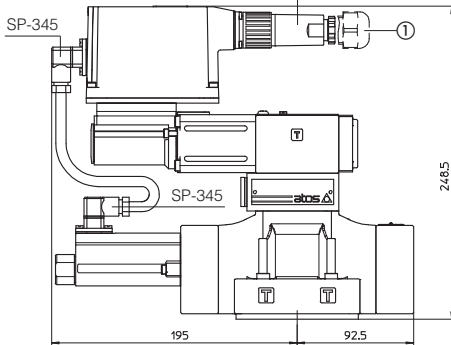
Diameter of ports X, Y: $\varnothing = 5$ mm;

Mass [kg]

DPZO-L-1	9
DPZO-LE-1	9,4
DPZO-LES-1	

DPZO-LE-1

SP-ZH-7P or SP-ZM-7P

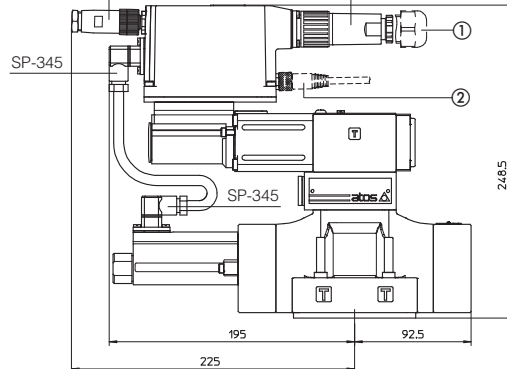


DPZO-LES-1

SP-ZH-5P/BP (for -BP)

SP-ZH-5P (for -PS and -BC)

SP-ZH-7P or SP-ZM-7P



① Dotted line = 12 pin connector SP-ZH-12P for options /SF, /SL, /SP, /Z

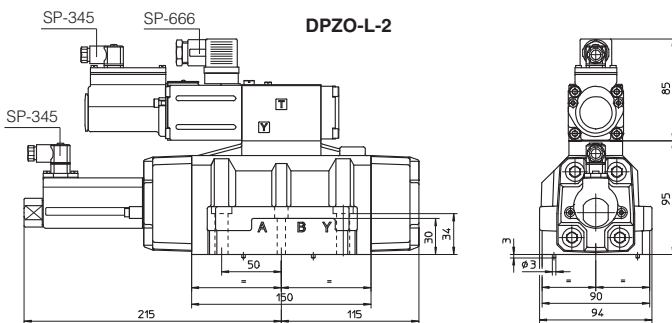
② = M8 connector SP-ZH-4P-M8/5 moulded on cable 5 mt lenght for pressure or force transducer (options /SL, /SP)

M8 connector SP-ZH-4P-M8/2-2 moulded with 2 cables, 2 mt lenght for 2 pressure transducers (options /SF)

NOTE:

For option /B the proportional solenoid, the position transducer and the electronics (in case of execution -LE and -LES) are at side of port B of the main stage.

DPZO-L(*)-2



ISO 4401: 2005

Mounting surface: 4401-07-07-0-05 (see table P005)

Fastening bolts:

4 socket head screws M10x50 class 12.9

Tightening torque = 70 Nm

2 socket head screws M6x40 class 12.9

Tightening torque = 15 Nm

Seals: 4 OR 130; 3 OR 109/70

Diameter of ports A, B, P, T: $\varnothing = 20$ mm;

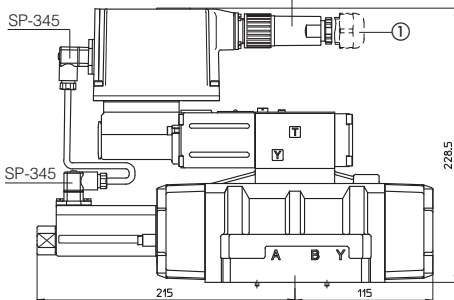
Diameter of ports X, Y: $\varnothing = 7$ mm;

Mass [kg]

DPZO-L-2	13,5
DPZO-LE-2	13,9
DPZO-LES-2	

DPZO-LE-2

SP-ZH-7P or SP-ZM-7P

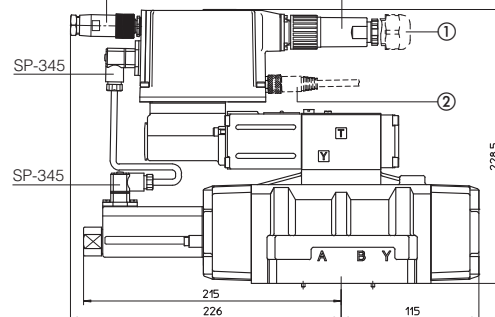


DPZO-LES-2

SP-ZH-5P/BP (for -BP)

SP-ZH-5P (for -PS and -BC)

SP-ZH-7P or SP-ZM-7P



① Dotted line = 12 pin connector SP-ZH-12P for options /SF, /SL, /SP, /Z

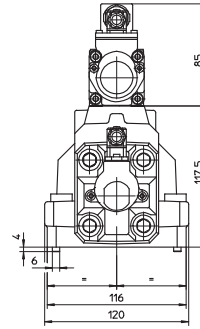
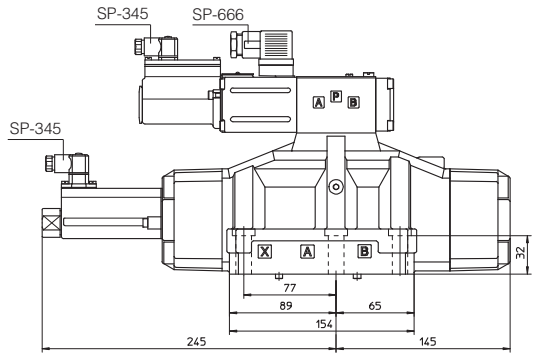
② = M8 connector SP-ZH-4P-M8/5 moulded on cable 5 mt lenght for pressure or force transducer (options /SL, /SP)

M8 connector SP-ZH-4P-M8/2-2 moulded with 2 cables, 2 mt lenght for 2 pressure transducers (options /SF)

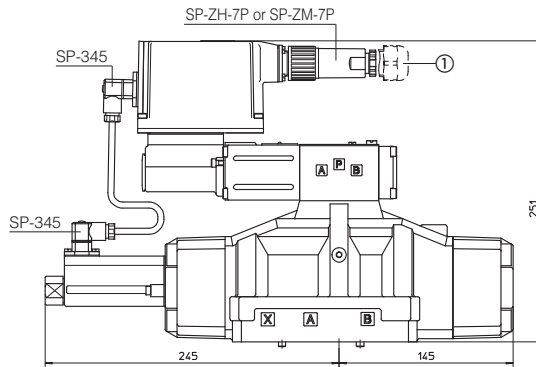
NOTE: The overall height is increased by 30 mm for /G option (0,9 kg).

For option /B the proportional solenoid, the position transducer and the electronics (in case of execution -LE and -LES) are at side of port B of the main stage.

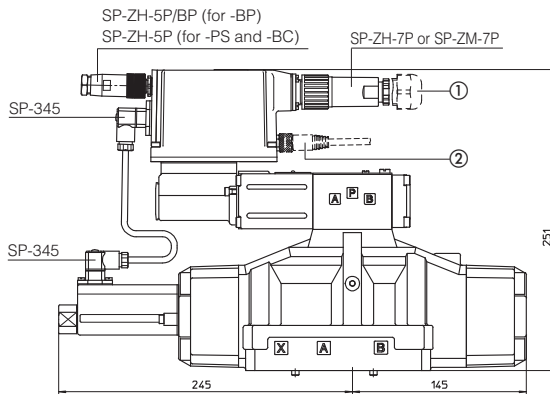
DPZO-L(*)-3



DPZO-L-3



DPZO-LE-3



DPZO-LES- *3

ISO 4401: 2005

Mounting surface: 4401-08-08-0-05 (see table P005)

Fastening bolts:

6 socket head screws M12x50 class 12.9

Tightening torque = 125 Nm

Seals: 4 OR 4112; 3 OR 3056

Diameter of ports A, B, P, T: $\varnothing = 24$ mm;

Diameter of ports X, Y: $\varnothing = 7$ mm;

Mass [kg]

DPZO-L-3	17,5
DPZO-LE-3	18,4
DPZO-LES-3	

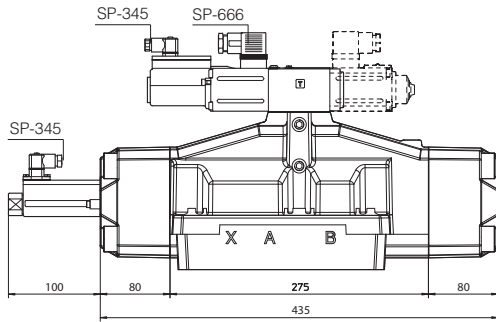
① Dotted line = 12 pin connector SP-ZH-12P for options /SF, /SL, /SP, /Z

② = M8 connector SP-ZH-4P-M8/5 moulded on cable 5 mt lenght for pressure or force transducer (options /SL, /SP)
M8 connector SP-ZH-4P-M8/2-2 moulded with 2 cables, 2 mt lenght for 2 pressure transducers (options /SF)

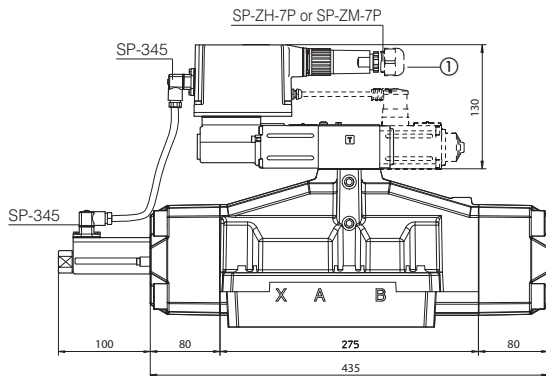
NOTE: The overall height is increased by 40 mm for /G option (0,9 kg).

For option /B the proportional solenoid, the position transducer and the electronics (in case of execution -LE and -LES) are at side of port B of the main stage.

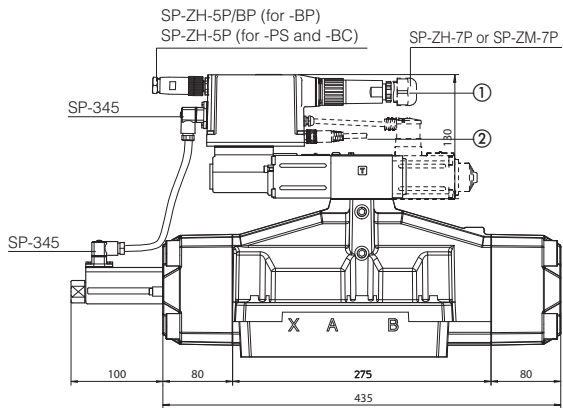
DPZO-L(*)-6



DPZO-L-3



DPZO-LE-3



DPZO-LES- *3

ISO 4401: 2005

Mounting surface: 4401-08-08-0-05 (see table P005)

Fastening bolts:

6 socket head screws M12x50 class 12.9

Tightening torque = 125 Nm

Seals: 4 OR 4112; 3 OR 3056

Diameter of ports A, B, P, T: $\varnothing = 24$ mm;

Diameter of ports X, Y: $\varnothing = 7$ mm;

Mass [kg]

DPZO-L-6	42,5
DPZO-LE-6	43,1
DPZO-LES-6	43,1

① Dotted line = 12 pin connector SP-ZH-12P for options /SF, /SL, /SP, /Z

② = M8 connector SP-ZH-4P-M8/5 moulded on cable 5 mt length for pressure or force transducer (options /SL, /SP)
M8 connector SP-ZH-4P-M8/2-2 moulded with 2 cables, 2 mt length for 2 pressure transducers (options /SF)

NOTE: The overall height is increased by 40 mm for /G option (0,9 kg).

For option /B the proportional solenoid, the position transducer and the electronics (in case of execution -LE and -LES) are at side of port B of the main stage.

17 MODEL CODES OF POWER SUPPLY AND COMMUNICATION CONNECTORS (to be ordered separately)

VALVE VERSION	-L		-LE, -LES		-LE/Z -LES /Z, /SF, /SL, /SP	LES -PS, -BC	LES -BP	LES /SF, /SL, /SP
	Power supply	Transducer						
CONNECTOR CODE	SP-666	SP-345	SP-ZH-7P	SP-ZM-7P	SP-ZH-12P	SP-ZH-5P	SP-ZH-5P/BP	SP-ZH-4P-M8/* (1)
PROTECTION DEGREE	IP65	IP65	IP67	IP67	IP67	IP67	IP67	IP67
DATA SHEET	K500		G200, G210, K500			G210, K500		G212, K500

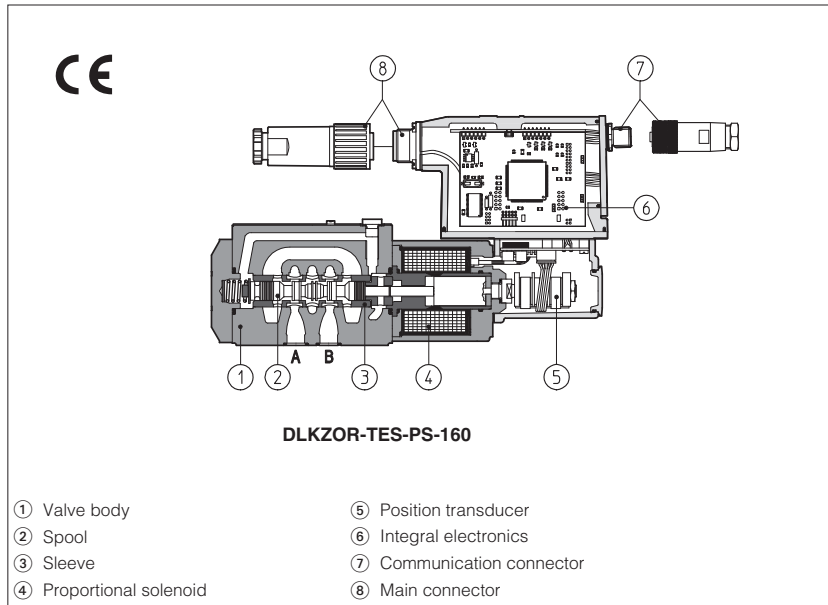
(1) M8 connector SP-ZH-4P-M8/5 moulded on cable 5 mt length for pressure or force transducer (options /SL, /SP)

M8 connector SP-ZH-4P-M8/2-2 moulded with 2 cables, 2 mt length for 2 pressure transducers (options /SF)

connectors supplied with the valve

Servoproportional valves type DLHZO and DLKZOR

sleeve execution, direct operated, with position transducer, ISO 4401 size 06 and 10



DLKZOR-TEs-PS-160

- ① Valve body
- ② Spool
- ③ Sleeve
- ④ Proportional solenoid
- ⑤ Position transducer
- ⑥ Integral electronics
- ⑦ Communication connector
- ⑧ Main connector

1 MODEL CODE

DLHZO - TES - PS - 0 4 0 - L 7 3 / * / ** / *

DLHZO = size 06
DLKZOR = size 10

T = with position transducer
TE = as T plus integral electronics
TES = as T plus integral digital electronics

Communication interfaces (only for TES)
PS = Serial
BC = CANopen
BP = PROFIBUS DP

Valve size, see section 2
0 = ISO 4401 size 06 1 = ISO 4401 size 10

Valve configuration, see section 2
4 = spring offset with fail safe
6 = spring offset

0 = zero overlapping

Spool type (regulating characteristics)
L = linear;
D = differential-linear (as L, but with P-A = Q, P-B = Q/2) (1)
DT = as D, but with non linear regulation (1)
T = not linear regulation (1)
V = progressive

0, 1, 3, 5, 7 = spool size, see section 3

Fail safe configuration (de-energized solenoid):
1 = A, B, P, T with positive overlapping (20% of spool stroke)
3 = P positive overlapping (20% of spool stroke); A, B, T negative

Note:

(1) Spool type D, DT and T are available only for valve configuration with fail safe position DLHZO-*040 and DLKZOR-*140

Synthetic fluids
WG = water-glycol
PE = phosphate ester

Series number

Hydraulic options, see section 4:

B = solenoid, integral electronics and position transducer at side of port A
Y = external drain

Electronics options, for -TE execution see section 7:

F = fault signal
I = current reference input and monitor (4÷20 mA)
Q = enable signal
Z = enable, fault and monitor signals (12 pin connector)

Electronics options, for -TES execution see section 9:

I = current reference input and monitor (4÷20mA)
Z = double power supply, enable fault and monitor signals (12 pin connector)

Special options for -TES execution see section 9:

SF = additional closed loop force control, with two remote pressure transducers
SL = additional closed loop force control with one remote load cell
SP = additional closed loop pressure control with one remote pressure transducer
C = current feedback interface for transducer(s) only for options /SF, /SL, /SP

DLHZO and DLKZOR are high performance servoproportional valves, direct operated, with sleeve execution and LVDT position transducer, which provide both directional and non compensated flow control according to the electronic reference signal.

They operate in association with electronic drivers, see section 2, which supply the proportional valves with proper current to align valve regulation to the reference signal supplied to the electronic driver.

They are available in different executions:

- -T, with integral position transducer ⑤;
- -TE, -TES as -T plus analog (TE) or digital (TES) integral electronics ⑥.

The 4-way spool ② is sliding into a precision - machined and hardened sleeve ③ for maximum overlapping accuracy. The sleeve ③ is mechanically forced into a 5-chambers body ①. The spool is directly operated by a proportional solenoids ④ and it is controlled in closed loop position by means of the LVDT position transducer ⑤.

The integral electronics ⑥ ensures factory presetting, fine functionality plus valve-to-valve interchangeability and simplified wiring and installation.

The electronic main connector ⑧ is fully interchangeable for -TE and -TES executions.

Standard 7 pin main connector is used for power supply, analog input reference and monitor signals.

12 pin connector is used for options /Z and /S*.

The special /S* options add a closed loop control of pressure (/SP) or force (/SF and /SL) to the basic closed loop spool position one.

Following communication interfaces ⑦ are available for the digital -TES execution:

- -PS, Serial communication interface for configuration, monitoring and firmware updating through Atos PC software

- -BC, CANopen interface
- -BP, PROFIBUS DP interface

The valves with -BC and -BP interfaces can be integrated into a fieldbus communication network and thus digitally operated by the machine control unit.

The coils are fully plastic encapsulated (insulation class H) and the valves have antivibration, antishock and weather-proof features.

Mounting surface: ISO 4401 sizes 06 and 10.

Max flow respectively up to 40 l/min and 100 l/min with valve differential pressure $\Delta p = 70$ bar, see table 3.

Max pressure = 350 bar

2 ELECTRONIC DRIVERS

Valve model	-T	-TE	-TES	-TES / SF, SL, SP
Drivers model	E-ME-T	E-RI-TE	E-RI-TES	E-RI-TES / SF, SL, SP
Data sheet	G140	G200	G210	G212

Note: For power supply and communication connector see section 15 and 17

3 HYDRAULIC CHARACTERISTICS (based on mineral oil ISO VG 46 at 50 °C)

Valve model	DLHZO-T*											DLKZOR-T*						
Pressure limits [bar]	ports P, A, B = 350; T = 210 (250 with external drain /Y)											ports P, A, B = 315; T = 210 (250 with external drain /Y)						
Spool	L0	L1	V1	L3	V3	L5	T5	L7	T7	V7	D7	DT7	L3	L7	T7	V7	D7	DT7
Max flow (1) [l/min]	2,5	4,5	5	9	13	18				26	26÷13		40		60			60÷33
at Δp = 30 bar	4	7	8	14	20	28				40	40÷20		60		100			100÷50
at Δp = 70 bar	8	14	16	30	40	50				70	70÷40		90		160			160÷80
max permissible flow																		
Leakage [cm³/min] at P = 100 bar (2)	<100	<200	<100	<300	<150	<500	<200	<900	<200	<200	<700	<200	<1000	<1500	<400	<400	<1200	<400
Fail safe connections	P → A			P → B			A → T			B → T								
Leakage [cm³/min] at P = 100 bar (3)	Fail safe 1			Fail safe 3									Fail safe 1			Fail safe 3		
Flow [l/min] (4)	DLHZO			DLKZOR			Fail safe 3						Fail safe 1			Fail safe 3		
Response time [ms]	≤ 10											≤ 15						
Hysteresis [%]	≤ 0,1%											≤ 0,1%						
Thermal drift	zero point displacement < 1% at ΔT = 40°C																	

Notes:

- Above performance data refer to valves coupled with Atos electronic drivers, see sections 2.
 - The flow regulated by the directional proportional valves is not pressure compensated, thus it is affected by the load variations. To keep constant the regulated flow under different load conditions, modular pressure compensators are available (see tab. D150).
- (1) For different Δp, the max flow is in accordance to the diagrams in section 13.2
 (2) Referred to spool in neutral position and 50°C oil temperature.
 (3) Referred to spool in fail safe position and 50°C oil temperature.
 (4) Referred to spool in fail safe position at Δp = 35 bar per edge and 50°C oil temperature.

4 HYDRAULIC OPTIONS

- 4.1 Option /B** Solenoid, integral electronics and position transducer at side of port A.
4.2 Option /Y External drain is mandatory if the pressure in port T exceeds 160 bar.

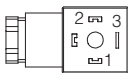
5 GENERAL NOTES

DLHZO and DLKZOR servoproportional valves 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.

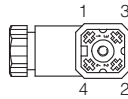
The electrical signals of the valve (e.g. monitor signals) must not be directly used to activate safety functions, like to switch-ON/OFF the machine's safety components, as prescribed by the European standards (Safety requirements of fluid technology systems and components-hydraulics, EN-982).

6 CONNECTIONS FOR -T EXECUTION

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



POSITION TRANSDUCER CONNECTOR	
PIN	Signal description
1	OUTPUT SIGNAL
2	SUPPLY -15 V _{dc}
3	SUPPLY +15 V _{dc}
4	GND



7 ANALOG INTEGRAL DRIVERS -TE - OPTIONS

Standard driver execution provides on the 7 pin main connector:

- Power supply** - 24V_{dc} must be appropriately stabilized or rectified and filtered; a 2,5 A safety fuse is required in series to the driver power supply. Apply at least a 10000 μF/40 V capacitance to single phase rectifiers or a 4700 μF/40 V capacitance to three phase rectifiers
- Reference input signal** - analog differential input with ±10 V_{dc} nominal range (pin D,E), proportional to desired valve spool position
- Monitor output signal** - analog output signal proportional to the actual valve's spool position with ±10 V_{dc} nominal range
- Following options are available to adapt standard execution to special application requirements:

7.1 Option /F

It provides a Fault output signal in place of the Monitor output signal, to indicate fault conditions of the driver (cable interruption of spool transducers or reference signal - for /I option): Fault presence corresponds to 0 V_{dc}, normal working corresponds to 24 V_{dc}.

7.2 Option /I

It provides the 4±20 mA current reference and monitor signals instead of the standard ±10 V_{dc}. It 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.

7.3 Option /Q

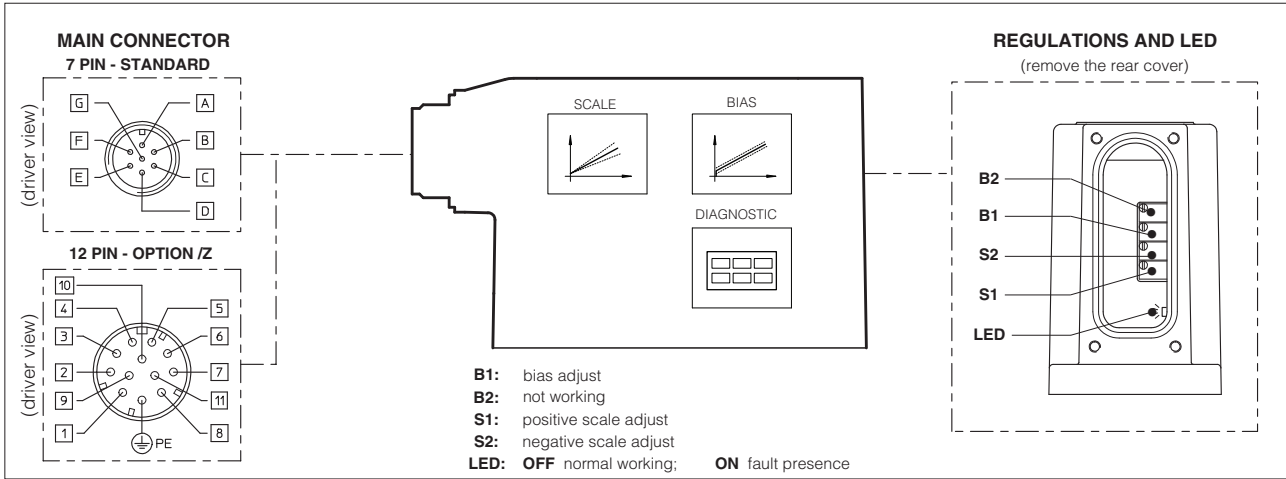
It provides the possibility to enable or disable the valve functioning without cutting the power supply (the valve functioning is disabled but the driver current output stage is still active). To enable the driver supply a 24V_{dc} on the enable input signal.

7.4 Option /Z

This option includes /F and /Q features, plus the Monitor output signal. When the driver is disabled (0 V_{dc} on Enable signal) Fault output is forced to 0 V_{dc}.

7.5 Possible combined options: /FI and /IZ

8 ANALOG INTEGRAL DRIVERS -TE - MAIN FUNCTIONS AND ELECTRONIC CONNECTIONS



8.1 ELECTRONIC CONNECTIONS - 7 & 12 PIN MAIN CONNECTORS

Standard 7pin	/Z option 12pin	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
A	1	V+	Power supply 24 Vdc for solenoid power stage and driver logic	Input - power supply
B	2	V0	Power supply 0 Vdc for solenoid power stage and driver logic	Gnd - power supply
C ⁽¹⁾	7	AGND	Ground - signal zero for MONITOR signal (for standard and /Z options)	Gnd - analog signal
	3	ENABLE	Enable (24 Vdc) or disable (0 Vdc) the driver (for /Q and /Z options)	Input - on/off signal
D	4	INPUT+	Reference analog differential input: ± 10 Vdc maximum range (4 \div 20 mA for /I option)	Input - analog signal
E	5	INPUT -		
F ⁽²⁾	6	MONITOR	Monitor analog output: ± 10 Vdc maximum range (4 \div 20 mA for /I option)	Output - analog signal
	11	FAULT	Fault (0V) or normal working (24V) (for F and /Z options)	Output - on/off signal
-	8	R_ENABLE	Repeat Enable - output repetition of Enable input	Output - on/off signal
-	9	NC	do not connect	Output - on/off signal
-	10	NC	do not connect	Output - on/off signal
G	PE	EARTH	Internally connected to the driver housing	

Notes (1) with /Q option ENABLE signal replaces AGND on pin C; MONITOR signal is referred to pin B

(2) with /F option FAULT signal replaces MONITOR on pin F.

A minimum time of 50ms to 100ms have to 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.

9 DIGITAL INTEGRAL DRIVERS -TES - OPTIONS

Standard driver execution provides on the 7 pin main connector:

Power supply - 24Vdc must be appropriately stabilized or rectified and filtered; a 2,5 A safety fuse is required in series to each driver power supply
Apply at least a 10000 μ F/40 V capacitance to single phase rectifiers or a 4700 μ F/40 V capacitance to three phase rectifiers

Reference input signal - analog differential input with ± 10 Vdc nominal range (pin D,E), proportional to desired valve spool position

Monitor output signal - analog output signal proportional to the actual valve's spool position with ± 10 Vdc nominal range

Following options are available to adapt standard execution to special application requirements:

9.1 Option /I

It provides 4 \div 20 mA current reference and monitor signals instead of the standard ± 10 V.

It 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.

9.2 Option /Z

It provides, on the 12 pin main connector, the following additional features:

Logic power supply

Separated 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. This condition allows to realize safety systems in compliance with European Norms EN13849-1 (ex EN954-1).

Enable Input Signal

To enable the driver, supply 24Vdc on pin 3 referred to pin 2: when the Enable signal is set to zero the valve functioning is disabled (zero current to the solenoid) but the driver current output stage is still active.

Fault Output Signal

Fault output signal indicates fault conditions of the driver (solenoid short circuits/not connected, reference signal cable broken for 4 \div 20mA input, etc.).
Fault presence corresponds to 0 Vdc, normal working corresponds to 24Vdc (pin 11 referred to pin 2): Fault status is not affected by the Enable input signal

9.3 Options /SP, /SF and /SL

These options add the closed loop control of pressure (/SP) or force (/SF and /SL) to the basic functions of proportional directional valves: a dedicated software alternates pressure (force) and valve's spool position controls depending on the actual hydraulic system conditions.

A dedicated connector is available for the additional transducers that are required to be interfaced to the valve's driver (1 pressure transducer for /SP, 2 pressure transducers for /SF or 1 load cell for /SL).

Main 12 pin connector is the same as /Z option plus two analog signals specific for the pressure (force) control: one for reference (pin 7) and one for monitor (pin 8).

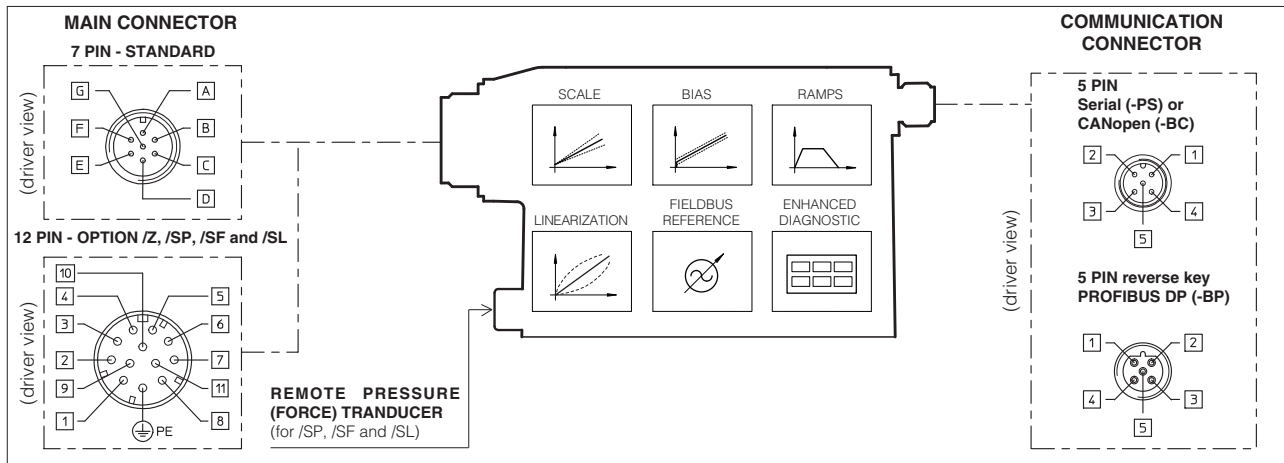
For further details please refer to the driver technical table **G212**.

9.4 Options /C

Options /CSP, /CSF and /CSL are available to connect pressure (force) transducers with 4 \div 20mA current output signal.

9.5 Possible combined options: /ISP, /ISF, /ISL, /ICSP, /ICSF, /ICSL, /ICISP, /ICISF, /ICISL and /IZ

10 DIGITAL INTEGRAL DRIVERS -TES - MAIN FUNCTIONS AND ELECTRONIC CONNECTIONS



10.1 ELECTRONIC CONNECTIONS - 7 & 12 PIN MAIN CONNECTORS

Standard 7pin	/Z option 12pin	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
A	1	V+	Power supply 24 Vdc for solenoid power stage (and for driver logic on 7 pin connection)	Input - power supply
B	2	V0	Power supply 0 Vdc for solenoid power stage (and for driver logic on 7 pin connection)	Gnd - power supply
-	3	ENABLE	Enable (24 Vdc) or disable (0 Vdc) the driver	Input - on/off signal
D	4	INPUT+	Reference analog input: ± 10 Vdc maximum range ($4 \div 20$ mA for /I option) standard: differential input; /Z option: common mode INPUT+ referred to AGND	Input - analog signal
E	-	INPUT -		
C	5	AGND	Ground - signal zero for MONITOR signal signal zero for INPUT+ signal (only for /Z option)	Gnd - analog signal
F	6	MONITOR	Monitor analog output: ± 10 Vdc maximum range ($4 \div 20$ mA for /I option)	Output - analog signal
-	7	NC	do not connect (pressure/force input for /SP, /SF and /SL options, see 9.3)	
-	8	NC	do not connect (pressure/force monitor for /SP, /SF and /SL options, see 9.3)	
-	9	VL+	Power supply 24 Vdc for driver logic	Input - power supply
-	10	VL0	Power supply 0 Vdc for driver logic	Gnd - power supply
-	11	FAULT	Fault (0V) or normal working (24V)	Output - on/off signal
G	PE	EARTH	Internally connected to the driver housing	

Note: 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.

10.2 ELECTRONIC CONNECTIONS - 5 PIN COMMUNICATION CONNECTORS

PIN	-PS Serial		-BC CANopen		-BP PROFIBUS DP	
	SIGNAL	TECHNICAL SPECIFICATION	SIGNAL	TECHNICAL SPECIFICATION	SIGNAL	TECHNICAL SPECIFICATION
1	NC	do not connect	CAN_SHLD	Shield	+5V	for termination
2	NC	do not connect	NC	do not connect	LINE-A	Bus line (high)
3	RS_GND	Signal zero data line	CAN_GND	Signal zero data line	DGND	data line and termination Signal zero
4	RS_RX	Valves receiving data line	CAN_H	Bus line (high)	LINE-B	Bus line (low)
5	RS_TX	Valves transmitting data line	CAN_L	Bus line (low)	SHIELD	

11 SOFTWARE TOOLS

The driver configuration and parameters can be easily set with the Atos E-SW programming software, available in three different versions according to the driver's communication execution: E-SW-PS (Serial), E-SW-BC (CANopen) and E-SW-BP (PROFIBUS DP).

For a more detailed description of software interface, PC requirements, adapters, cables and terminators, please refer to technical table G500.

Programming software, must be ordered separately:

E-SW-* (mandatory - first supply) = Dvd including E-SW-* software installer and operator manuals; it allows the registration to Atos digital service

E-SW-*N (optional - next supplies) = as above but not allowing the registration to Atos digital service

On first supply of the E-SW-* software, it is required to apply for the registration in the Atos download area: www.download.atos.com.

Once the registration is completed, the password will be sent by email.

The software remains active for 10 days from the installation date and then it stops until the user inputs his password.

With the password you can also download, in your personal area, the latest releases of the Atos software, manuals, drivers and configuration files.

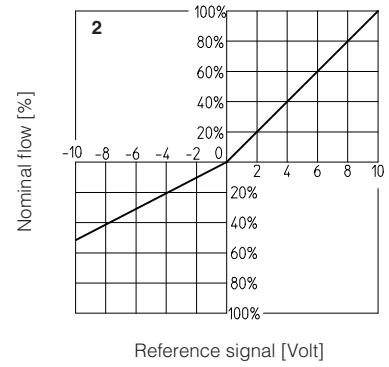
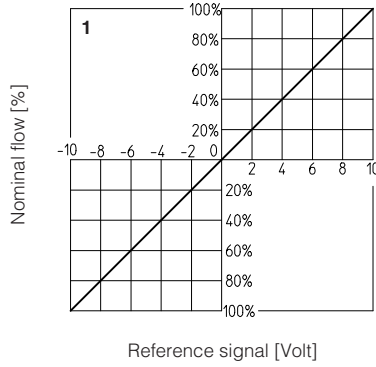
12 MAIN CHARACTERISTICS OF PROPORTIONAL DIRECTIONAL VALVES

Assembly position	Any position	
Subplate surface finishing	Roughness index, $\sqrt{0.4}$ flatness ratio 0,01/100 (ISO 1101)	
Ambient temperature	-20°C \div +70°C for -T execution; -20°C \div +60°C for -TE and TES executions	
Fluid	Hydraulic oil as per DIN 51524 ... 535 for other fluids see section I	
Recommended viscosity	15 \div 100 mm ² /s at 40°C (ISO VG 15 \div 100)	
Fluid contamination class	ISO 18/15 achieved with in line filters of 10 μ m and $\beta_{10} \geq 75$ (recommended)	
Fluid temperature	-20°C +60°C (standard and /WG seals) -20°C +80°C (/PE seals)	
Valve model	DLHZO-T*	DLKZOR-T*
Coil resistance R at 20°C	3 \div 3,3 Ω	3,8 \div 4,1 Ω
Max. solenoid current	2,6 A	3 A
Max. power	35 Watt	40 Watt
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 (CEI EN-60529)	IP65 for -T execution; IP67 for -TE and -TES executions	
Duty factor	Continuous rating (ED=100%)	

13 DIAGRAMS (based on mineral oil ISO VG 46 at 50 °C)

13.1 Regulation diagrams

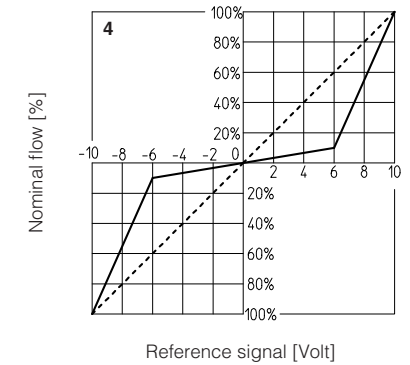
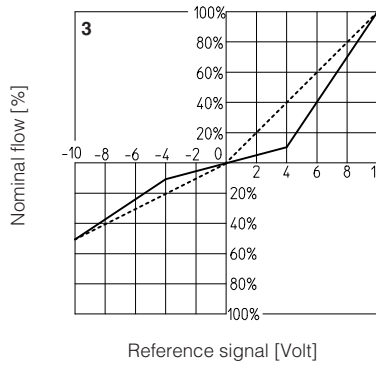
- 1 = Linear spools L
- 2 = Differential - linear spool D7



- 3 = Differential non linear spool DT7
- 4 = Non linear spool T5 (only for DLHZO)

T5 and T7 spool types are specific for fine low flow control in the range from 0 to 60% (T5) and 0 to 40% (T7) of max spool stroke. The non linear characteristics of the spool is compensated by the electronic driver, so the final valve regulation is resulting linear respect the reference signal (dotted line).

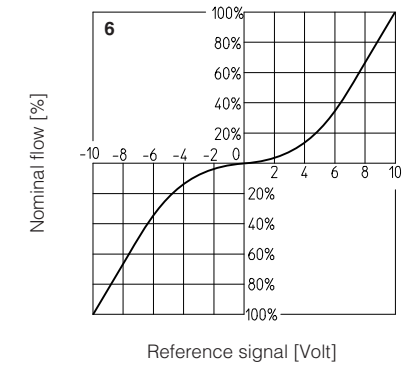
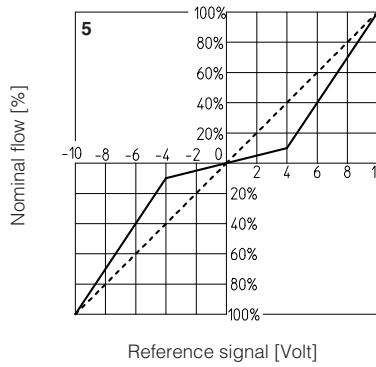
DT7 has the same characteristic of T7 but it is specific for applications with cylinders with area ratio 1:2



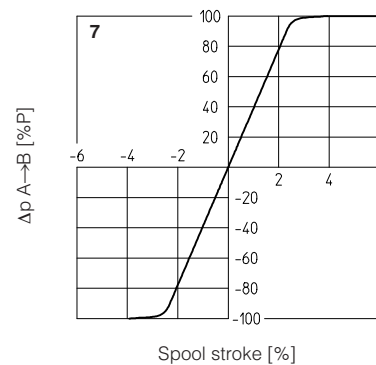
- 5 = Non linear spool T7
- 6 = Progressive spool V

Note:
Hydraulic configuration vs. reference signal:

Standard:	Reference signal	0 ÷ +10 V } P → A / B → T
		12 ÷ 20 mA }
	Reference signal	0 ÷ -10 V } P → B / A → T
		4 ÷ 12 mA }
option /B:	Reference signal	0 ÷ +10 V } P → B / A → T
		12 ÷ 20 mA }
	Reference signal	0 ÷ -10 V } P → A / B → T
		4 ÷ 12 mA }



- 7 = Pressure gain



13.2 Flow / Δp diagrams

Stated at 100% of spool stroke

DLHZO:

1 = spool L7, T7, V7, D7, DT7

2 = spool L5, T5

3 = spool V3

4 = spool L3

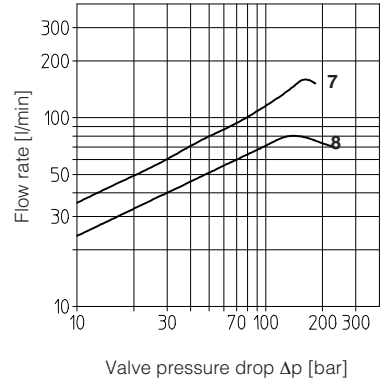
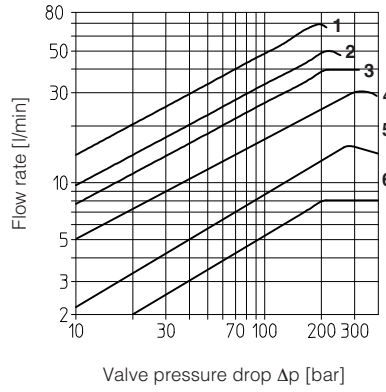
5 = spool L1, V1

6 = spool L0

DLKZOR:

7 = spool L7, T7, V7, D7, DT7

8 = spool L3



13.3 Bode diagrams

Stated at nominal hydraulic conditions

DLHZO:

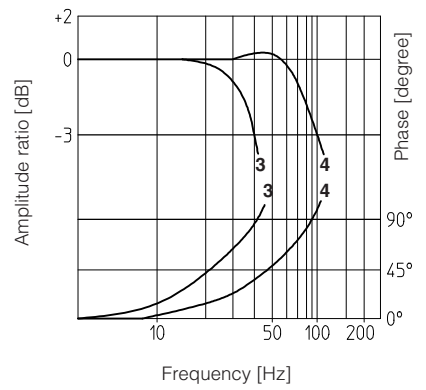
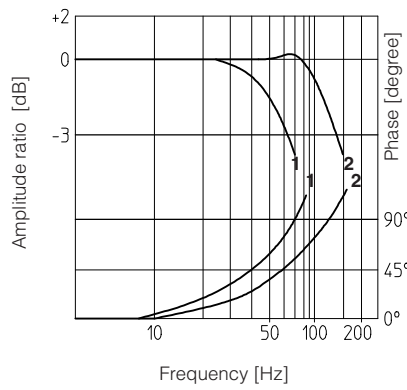
1 = \pm 100% nominal stroke

2 = \pm 5% nominal stroke

DLKZOR:

3 = \pm 100% nominal stroke

4 = \pm 5% nominal stroke



13.4 Dynamic response

The response times in section 3 have to be considered as average values.

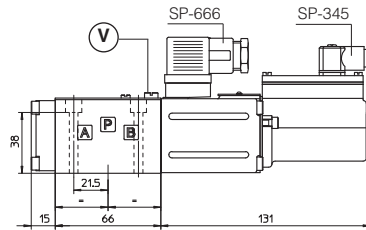
For the valves with digital electronics the dynamics performances can be optimized by setting the internal software parameters.

14 INSTALLATION DIMENSIONS [mm]

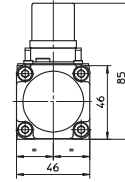
ISO 4401: 2005

Mounting surface: 4401-03-02-0-05 (see table P005)
(for /Y version, surface: 4401-03-03-0-05 without X port)

Fastening bolts:
 4 socket head screws M5x50 class 12.9
 Tightening torque = 8 Nm
 Seals: 4 OR 108; 1 OR 2025/70
 Diameter of ports A, B, P, T: Ø 7,5 mm (max)
 Diameter of port Y: Ø 3,2 mm (only for /Y option)



DLHZO-T



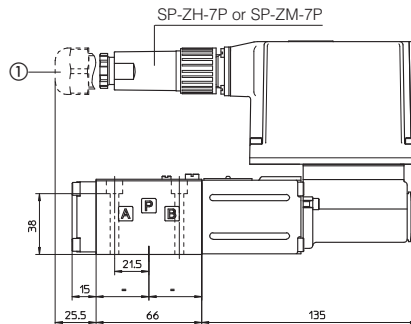
Mass: 2,3 kg

Note: for option /B the solenoid and the position transducer are at side of port A

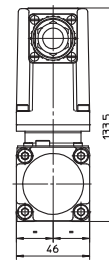
Ⓟ = Air bleed off

-TE EXECUTION

① Dotted line = 12 poles connector SP-ZH-12P for option /Z



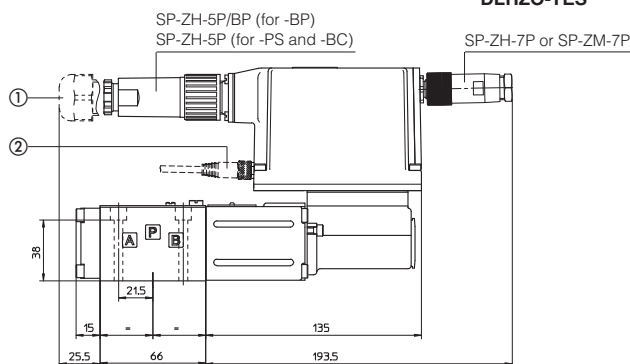
DLHZO-TE



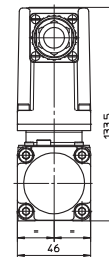
Mass: 2,8 kg

-TES EXECUTION

① Dotted line = 12 pin connector SP-ZH-12P for options /SF, /SL, /SP, /Z
 ② Dotted line = M8 connector SP-ZH-4P-M8/5 moulded on cable 5 mt lenght for pressure or force transducer (options /SL, /SP)
 M8 connector SP-ZH-4P-M8/2-2 moulded with 2 cables, 2 mt lenght for 2 pressure transducers (options /SF)



DLHZO-TES



Mass: 2,8 kg

Note: for option /B the solenoid, the position transducer and the integral electronics are at side of port A

15 MODEL CODES OF POWER SUPPLY AND COMMUNICATION CONNECTORS (to be ordered separately)

VALVE VERSION	-T		-TE, -TES		-TE/Z	TES -PS, -BC	TES -BP	TES /SF, /SL, /SP
	Power supply	Transducer			-TES /Z, /SF, /SL, /SP			
CONNECTOR CODE	SP-666	SP-345	SP-ZH-7P	SP-ZM-7P	SP-ZH-12P	SP-ZH-5P	SP-ZH-5P/BP	SP-ZH-4P-M8/* (1)
PROTECTION DEGREE	IP65	IP65	IP67	IP67	IP67	IP67	IP67	IP67
DATA SHEET	K500		G200, G210, K500			G210, K500		G212, K500

(1) M8 connector SP-ZH-4P-M8/5 moulded on cable 5 mt lenght for pressure or force transducer (options /SL, /SP)
 M8 connector SP-ZH-4P-M8/2-2 moulded with 2 cables, 2 mt lenght for 2 pressure transducers (options /SF)

connectors supplied with the valve

16 INSTALLATION DIMENSIONS [mm]

ISO 4401: 2005

Mounting surface: 4401-05-04-0-05 (see table P005)

(for /Y version, surface: 4401-05-05-0-05 without X port)

Fastening bolts:

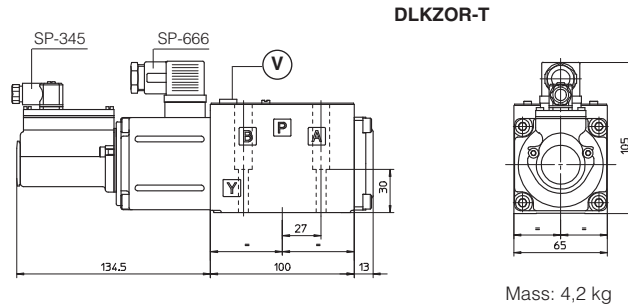
4 socket head screws M6x40 class 12.9

Tightening torque = 15 Nm

Seals: 5 OR 2050; 1 OR 108

Diameter of ports A, B, P, T: Ø 11,2 mm (max)

Diameter of port Y: Ø 5 mm (only for /Y option)

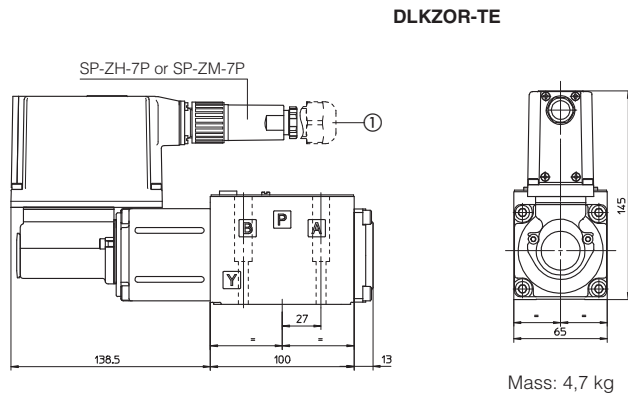


Note: for option /B the solenoid and the position transducer are at side of port A

Ⓧ = Air bleed off

-TE EXECUTION

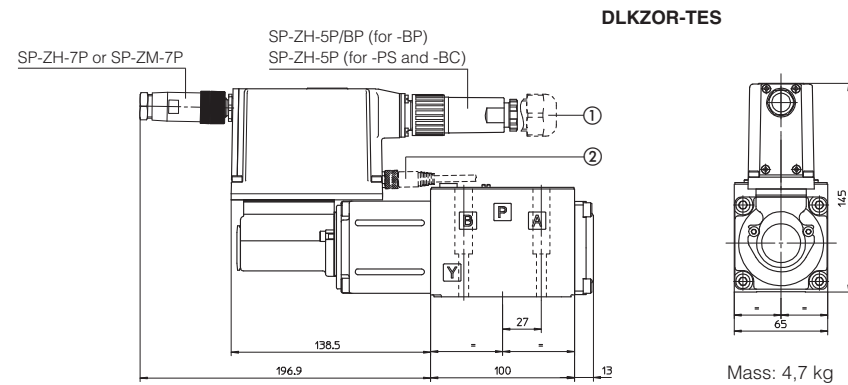
① Dotted line = 12 poles connector SP-ZH-12P for option /Z



-TES EXECUTION

① Dotted line = 12 pin connector SP-ZH-12P for options /SF, /SL, /SP, /Z

② Dotted line = M8 connector SP-ZH-4P-M8/5 moulded on cable 5 mt lenght for pressure or force transducer (options /SL, /SP)
M8 connector SP-ZH-4P-M8/2-2 moulded with 2 cables, 2 mt lenght for 2 pressure transducers (options /SF)



Note: for option /B the solenoid, the position transducer and the integral electronics are at side of port A

17 MODEL CODES OF POWER SUPPLY AND COMMUNICATION CONNECTORS (to be ordered separately)

VALVE VERSION	-T		-TE, -TES		-TE/Z	TES -PS, -BC	TES -BP	TES /SF, /SL, /SP
	Power supply	Transducer			-TES /Z, /SF, /SL, /SP			
CONNECTOR CODE	SP-666	SP-345	SP-ZH-7P	SP-ZM-7P	SP-ZH-12P	SP-ZH-5P	SP-ZH-5P/BP	SP-ZH-4P-M8* (1)
PROTECTION DEGREE	IP65	IP65	IP67	IP67	IP67	IP67	IP67	IP67
DATA SHEET	K500		G200, G210, K500			G210, K500		G212, K500

(1) M8 connector SP-ZH-4P-M8/5 moulded on cable 5 mt lenght for pressure or force transducer (options /SL, /SP)
M8 connector SP-ZH-4P-M8/2-2 moulded with 2 cables, 2 mt lenght for 2 pressure transducers (options /SF)

connectors supplied with the valve

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- pompy zębate, rozdzielacze, zawory, dzielniki strumienia*
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