atos ▲

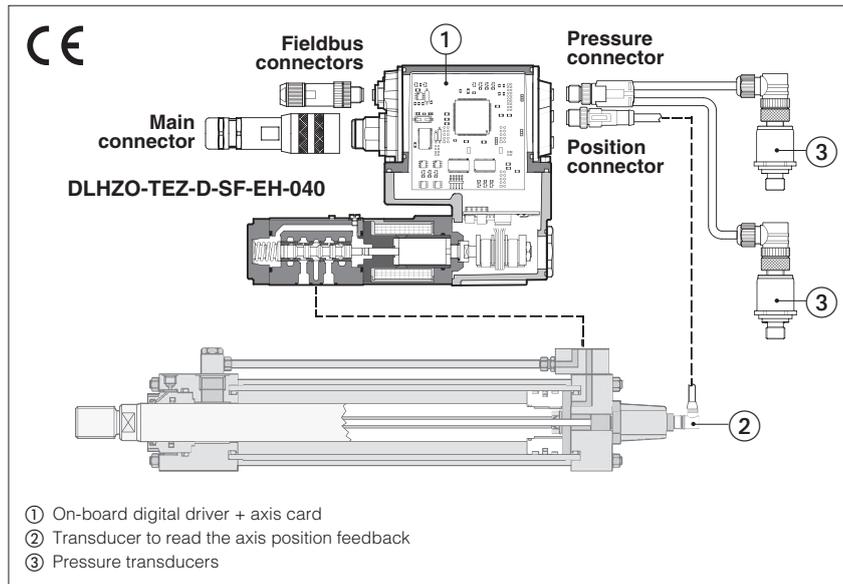Table **FS610-0/E**

Digital servoproportionals with on-board axis card
direct, single solenoid, sleeve execution, with LVDT transducer and zero spool overlap

CE

Fieldbus connectors
Pressure connector
Main connector
Position connector

DLHZO-TEZ-D-SF-EH-040

① On-board digital driver + axis card
② Transducer to read the axis position feedback
③ Pressure transducers

DLHZO-TEZ, DLKZOR-TEZ

Digital servoproportional directional valves, direct, single solenoid, sleeve execution, with on-board digital driver + axis card, LVDT position transducer and zero spool overlap for best performances in any position closed loop controls of linear or rotative hydraulic actuator. The sleeve execution grants high regulation accuracy and response sensitivity.
The controlled actuator has to be equipped with transducer (analog, potentiometer, SSI or Encoder) to read the axis position feedback.
The valve can be operated via an external reference signal or automatic cycle, see section 2 .

Alternated P/Q controls, see 3 :
SF, **SL** = alternated force control added to the basic position one

Safety options TÜV certified, see 7 :
U = safe double power supply
K = safe on/off signals

DLHZO:
Size: **06** -ISO 4401
Max flow: **70 l/min**
Max pressure: **350 bar**

DLKZOR:
Size: **10** -ISO 4401
Max flow: **160 l/min**
Max pressure: **315 bar**

---

1 MODEL CODE

| DLHZO | - | TEZ | - | D | - | SN | - | NP | - | 0 | 40 | - | L | 7 | 3 | / | * | | * | / | * |

Servoproportional directional valves, direct
DLHZO = size 06
DLKZOR = size 10

TEZ = on-board digital driver + axis card, one LVDT transducer

Position transducer type:
A = Analog (standard, potentiometer)
D = Digital (SSI, Encoder)

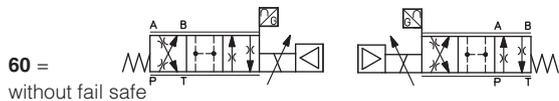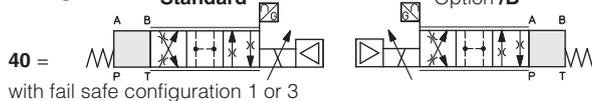**Alternated P/Q controls**:
SN = none
SF = force control (2 pressure transducers)
SL = force control (1 load cell)

Fieldbus interface, USB port always present:
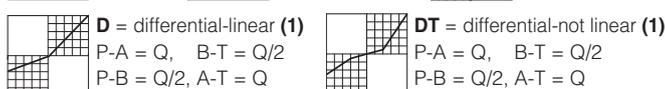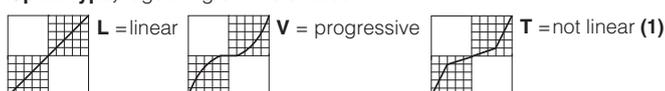**NP** = Not Present
BC = CANopen   **EW** = POWERLINK
BP = PROFIBUS DP   **EI** = EtherNet/IP
EH = EtherCAT   **EP** = PROFINET RT/IRT

Valve size ISO 4401:   **0** = 06   **1** = 10

Configuration:
Standard   Option **/B**

40 =
with fail safe configuration 1 or 3

60 =
without fail safe

Spool type, regulating characteristics:
L =linear   **V** = progressive   **T** =not linear **(1)**

D = differential-linear **(1)**
P-A = Q,   B-T = Q/2
P-B = Q/2, A-T = Q

DT = differential-not linear **(1)**
P-A = Q,   B-T = Q/2
P-B = Q/2, A-T = Q

(1) Not available for configuration **60**   **(2)** For possible combined options, see section 16

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

Series number

Hydraulic options (2):
B = solenoid with on-board digital driver + axis card and position transducer at side of port A
Y = external drain

Electronics options (2):
C = current feedback for pressure transducer 4÷20mA (omit for std voltage ±10VDC) - only for **SF, SL**
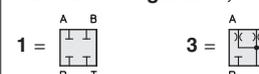**I** = current reference input and monitor 4÷20mA (omit for std voltage ±10VDC)

Safety options TÜV certified **(2)**:
U = safe double power supply
K = safe on/off signals
See section 7

SAFETY CERTIFIED

Fail safe configuration, see section 13 :

1 =   **3** =

Note: select **1** for configuration **60** even without fail safe

Spool size:	**0**(L)	**1**(L)	**1**(V)	**3**(L)	**3**(T)	**3**(V)	**5**(L,T)	**7**(L,T,V,D,DT)
DLHZO =	4	7	8	14	-	20	28	40
DLKZOR =	-	-	-	60	60	-	-	100

Nominal flow (l/min) at Δp 70bar P-T

2 POSITION CONTROL
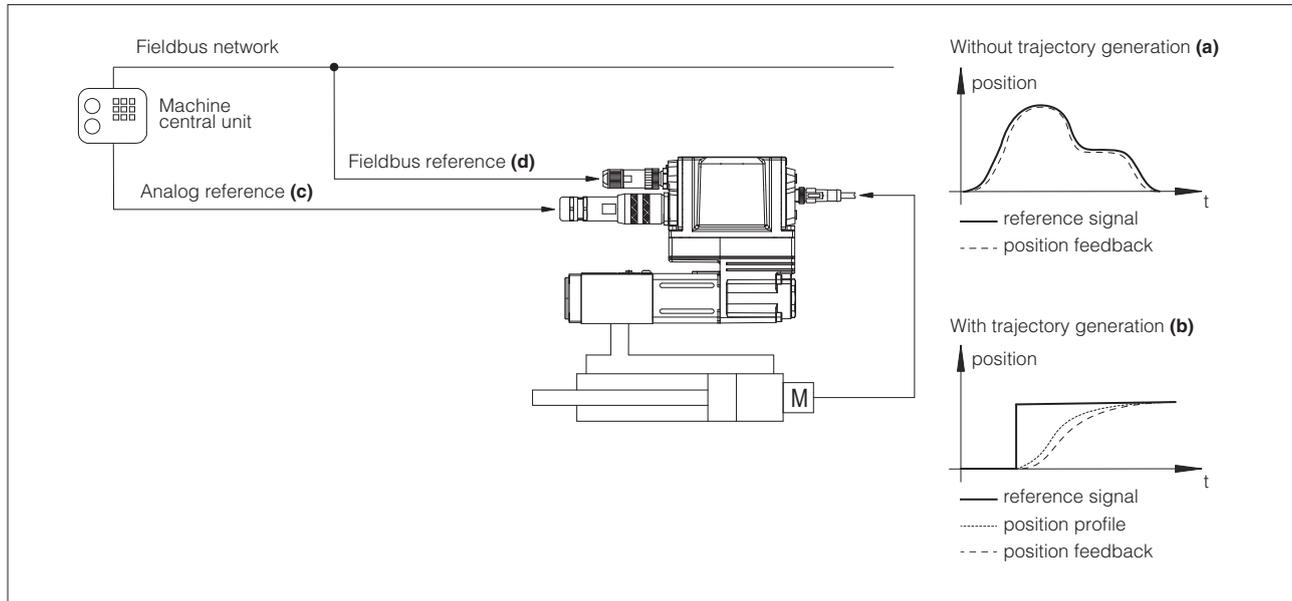
2.1 External reference signal

Axis card controls in closed loop the actuator position according to a reference signal from the machine central unit.

Position profile can be managed in two ways (software selectable):
- Without trajectory generation **(a)**: the axis card receives from the machine central unit the reference signal and follows it at any given instant
- With trajectory generation **(b)**: the axis card receives from the machine central unit just the final target position and internally generates a position profile limiting acceleration, velocity and deceleration
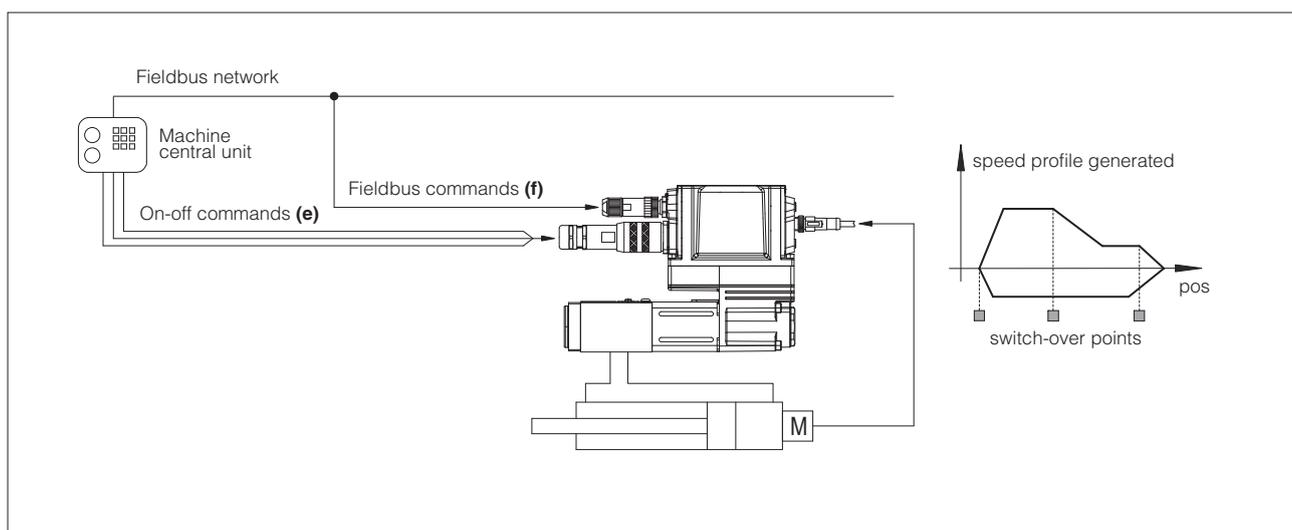
The reference signal can be software selected between Analog reference **(c)** and Fieldbus reference **(d)**.

Refer to the axis card user manual for further details on position control features.

2.2 Automatic cycle

Axis card controls in closed loop the actuator position according to an internally generated automatic cycle: only start, stop and switch-over commands are required from the machine electronic central unit by means On-off commands **(e)** or Fieldbus commands **(f)**.

Atos PC software allows to realize an automatic cycle according to the application requirements. Refer to the axis card user manual for further details on automatic cycle features.

3 | ALTERNATED POSITION / FORCE CONTROL

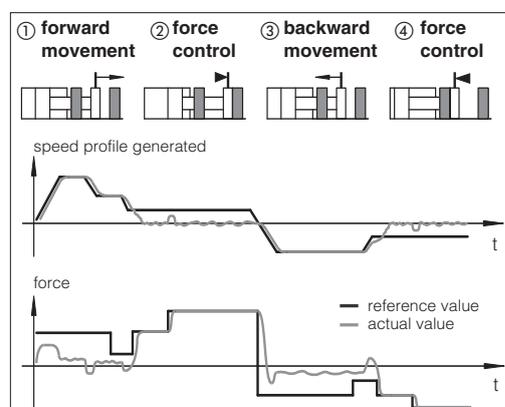**SF** and **SL** controls add the alternated force closed loop control to the actuator standard position control. Pressure or force remote transducers have to be installed on the actuator and interfaced to the valve, see below functional schemes.

The position/force controls are operated according to two separate reference signals and a dedicated algorithm automatically selects which control is active time by time.

The dynamics of the switching between the two controls can be regulated thanks to specific software setting, in order to avoid instability and vibrations.

Position control is active (see phase ① and ③ at side) when the actuator force is lower than the relevant reference signal - the valve controls the actuator position by closed-loop regulation.

Force control is active (see phase ② and ④ at side) when the actuator actual force, measured by remote transducers, grows up to the relevant reference signal - the axis card reduces the valve's regulation in order to limit the actuator force; if the force tends to decrease under its reference signal, the position control returns active.

① **forward movement**   ② **force control**   ③ **backward movement**   ④ **force control**

speed profile generated

force

— reference value
— actual value

Alternated control configurations

SF	SL
two remote pressure transducers have to be installed on the actuator's ports; the actuator force is calculated by the pressure feedbacks (Pa - Pb)	one load cell transducer has to be installed between the actuator and the controlled load

	T	valve spool transducer	M	actuator position transducer	P	pressure transducer	L	load cell

SF – position/force control
Adds force control to standard position control and permits to limit the max force in two directions controlling in closed loop the delta pressure acting on both sides of the hydraulic actuator. Two pressure transducers have to be installed on A and B hydraulic lines.

SL – position/force control
Adds force control to standard position control and permits to limit the max force in one or two directions controlling in closed loop the force performed by the hydraulic actuator. A load cell has to be installed on the hydraulic actuator.

General Notes:
- auxiliary check valves are recommended in case of specific hydraulic configuration requirements in absence of power supply or fault
- Atos technical office is available for additional evaluations related to specific applications

4 GENERAL NOTES

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

5 VALVE SETTINGS AND PROGRAMMING TOOLS

Valve's functional parameters and configurations, can be easily set and optimized using Atos Z-SW programming software connected via USB port to the axis card (see table **FS900**).
For fieldbus versions, the software permits valve's parameterization through USB port also if the axis card is connected to the central machine unit via fieldbus.
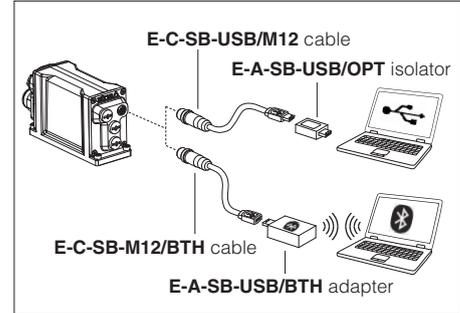
USB or Bluetooth connection

E-C-SB-USB/M12 cable
E-A-SB-USB/OPT isolator
E-C-SB-M12/BTH cable
E-A-SB-USB/BTH adapter

Z-SW-FULL   support: NP (USB)   PS (Serial)
                          BC (CANopen)   BP (PROFIBUS DP)   EH (EtherCAT)
                          EW (POWERLINK)   EI (EtherNet/IP)   EP (PROFINET)

Note: Z-SW programming software supports valves with option SF, SL for alternated control

⚠ **WARNING: axis card USB port is not isolated!** For E-C-SB-USB/M12 cable, the use of isolator adapter is highly recommended for PC protection (see tech table **GS500**)

⚠ **WARNING:** see tech table **GS500** for the list of countries where the Bluetooth adapter has been approved

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

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

7 SAFETY OPTIONS

Atos range of proportional directional valves, provides functional safety options **/U** and **/K** , designed to accomplish a safety function, intended to reduce the risk in process control systems.

They are **TÜV certified** in compliance to **IEC 61508 up to SIL 3 and ISO 13849 up to category 4, PL e**

SAFETY CERTIFIED

Safe double power supply, option **/U**: the axis card has separate power supplies for logic and solenoids. The safe condition is reached by cutting the electrical supply to solenoids, while electronics remains active for monitoring functions and fieldbus communication, see tech table **FY100**

Safety function via on/off signals, option **/K**: upon a disable command, the axis card checks the spool position and it provides on-off acknowledgement signal only when the valve is in safe condition, see tech table **FY200**

8 GENERAL CHARACTERISTICS

Assembly position	Any position
Subplate surface finishing to ISO 4401	Acceptable roughness index: Ra ≤0,8, recommended Ra 0,4 – Flatness ratio 0,01/100
MTTFd valves according to EN ISO 13849	150 years, see technical table P007
Ambient temperature range	**Standard** = -20°C ÷ +60°C **/PE** option = -20°C ÷ +60°C **/BT** option = -40°C ÷ +60°C
Storage temperature range	**Standard** = -20°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C
Surface protection	Zinc coating with black passivation, galvanic treatment (axis card housing)
Corrosion resistance	Salt spray test (EN ISO 9227) > 200 h
Compliance	CE according to EMC directive 2014/30/EU (Immunity: EN 61000-6-2; Emission: EN 61000-6-3) RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006

9 HYDRAULIC CHARACTERISTICS - based on mineral oil ISO VG 46 at 50 °C

Valve model						DLHZO								DLKZOR						
Pressure limits [bar]	ports **P**, **A**, **B** = 350; **T** = 210 (250 with external drain /Y) **Y** = 10												ports **P**, **A**, **B** = 315; **T** = 210 (250 with external drain /Y) **Y** = 10						
Spool type	L0	L1	V1	L3	V3	L5	T5	L7	T7	V7	D7	DT7	L3	T3	L7	T7	V7	D7	DT7
Nominal flow Δp P-T [l/min] **(1)** Δp= 30 bar	2,5	4,5	8	9	13	18		26			26÷13		40		60			60÷33	
Δp= 70 bar	4	7	12	14	20	28		40			40÷20		60		100			100÷50	
Max permissible flow	8	14	16	30	40	50		70			70÷40		90		160			160÷80	
Leakage **(2)** [cm³/min]	<100	<200	<100	<300	<150	<500	<200	<900	<200	<200	<700	<200	<1000	<400	<1500	<400	<400	<1200	<400
Response time **(3)** [ms]	≤ 10												≤ 15						
Hysteresis	≤ 0,1 [% of max regulation]																		
Repeatibility	± 0,1 [% of max regulation]																		
Thermal drift	zero point displacement < 1% at ΔT = 40°C																		

(1) For different Δp, the max flow is in accordance to the diagrams in section 12.2
(2) Referred to spool in neutral position and 50°C oil temperature
(3) 0-100% step signal

10 ELECTRICAL CHARACTERISTICS

Power supplies	Nominal : +24 V_{DC} Rectified and filtered : V_{RMS} = 20 ÷ 32 V_{MAX} (ripple max 10 % V_{PP})
Max power consumption	50 W
Max. solenoid current	**DLHZO** = 2,6 A **DLKZOR** = 3 A
Coil resistance R at 20°C	**DLHZO** = 3 ÷ 3,3 Ω **DLKZOR** = 3,8 ÷ 4,1 Ω
Analog input signals	Voltage: range ±10 V_{DC} (24 V_{MAX} tollerant) Input impedance: R_i > 50 kΩ Current: range ±20 mA Input impedance: R_i = 500 Ω
Monitor outputs	Output range: voltage ±10 V_{DC} @ max 5 mA current ±20 mA @ max 500 Ω load resistance
Enable input	Range: 0 ÷ 5 V_{DC} (OFF state), 9 ÷ 24 V_{DC} (ON state), 5 ÷ 9 V_{DC} (not accepted); Input impedance: R_i > 10 kΩ
Fault output	Output range: 0 ÷ 24 V_{DC} (ON state > [power supply - 2 V] ; OFF state < 1 V) @ max 50 mA; external negative voltage not allowed (e.g. due to inductive loads)
Position transducers power supply	+24 V_{DC} @ max 100 mA and +5 V_{DC} @ max 100 mA are software selectable; ±10 V_{DC} @ max 14 mA minimum load resistance 700 Ω
Pressure/Force transducer power supply (only for SF, SL)	+24V_{DC} @ max 100 mA (E-ATR-8 see tech table **GS465**)
Alarms	Solenoid not connected/short circuit, cable break with current reference signal, over/under temperature, valve spool transducer malfunctions, alarms history storage function
Insulation class	H (180°) Due to the occuring surface temperatures of the solenoid coils, the European standards ISO 13732-1 and EN982 must be taken into account
Protection degree to DIN EN60529	IP66 / IP67 with mating connectors
Duty factor	Continuous rating (ED=100%)
Tropicalization	Tropical coating on electronics PCB
Additional characteristics	Short circuit protection of solenoid's current supply; 3 leds for diagnostic; protection against reverse polarity of power supply
Electromagnetic compatibility (EMC)	According to Directive 2014/30/UE (Immunity: EN 61000-6-2; Emission: EN 61000-6-3)
Communication interface	USB Atos ASCII coding	CANopen EN50325-4 + DS408	PROFIBUS DP EN50170-2/IEC61158	EtherCAT, POWERLINK, EtherNet/IP, PROFINET IO RT / IRT EC 61158
Communication physical layer	not insulated USB 2.0 + USB OTG	optical insulated CAN ISO11898	optical insulated RS485	Fast Ethernet, insulated 100 Base TX
Recommended wiring cable	LiYCY shielded cables, see section 21

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

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

Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	20÷100 mm²/s - max allowed range 15 ÷ 380 mm²/s

Max fluid contamination level	normal operation	ISO4406 class 18/16/13 NAS1638 class 7	see also filter section at
	longer life	ISO4406 class 16/14/11 NAS1638 class 5	www.atos.com or KTF catalog

Hydraulic fluid	Suitable seals type	Classification	Ref. Standard
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

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

12.1 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)

5 = Non linear spool T3 (only for DLHZO) and T7
6 = Progressive spool V

T3, T5 and T7 spool types are specific for fine low flow control in the range from 0 to 60% (T5) and 0 to 40% (T3 and T7) of max spool stroke.
The non linear characteristics of the spool is compensated by the axis card, 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

Note:
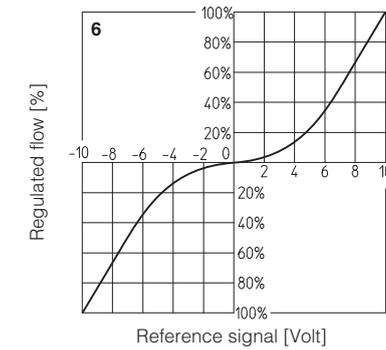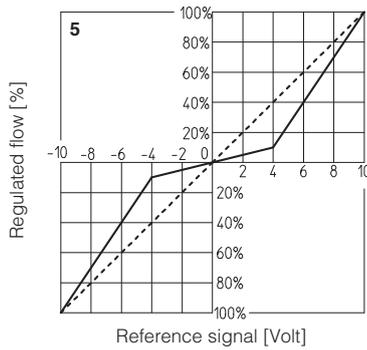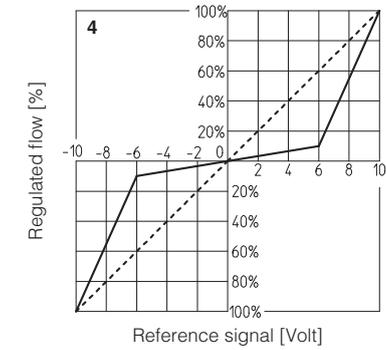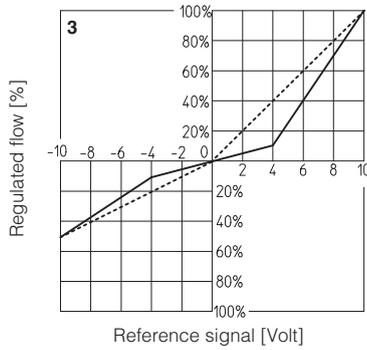Hydraulic configuration vs. reference signal:

Standard:
Reference signal $\left.\begin{array}{l} 0 \div +10\ V \\ 12 \div 20\ mA \end{array}\right\}$ P → A / B → T

Reference signal $\left.\begin{array}{l} 0 \div -10\ V \\ 12 \div 4\ mA \end{array}\right\}$ P → B / A → T

option /B:
Reference signal $\left.\begin{array}{l} 0 \div +10\ V \\ 12 \div 20\ mA \end{array}\right\}$ P → B / A → T

Reference signal $\left.\begin{array}{l} 0 \div -10\ V \\ 12 \div 4\ mA \end{array}\right\}$ P → A / B → T
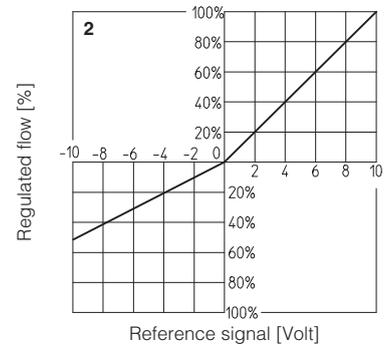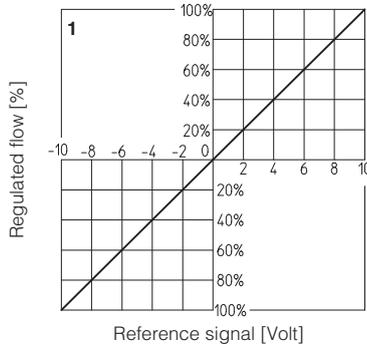
12.2 Flow /Δp diagrams
Stated at 100% of spool stroke

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
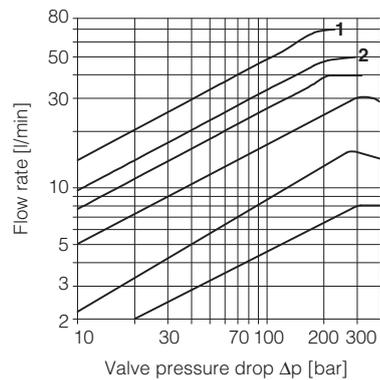
12.3 Pressure gain
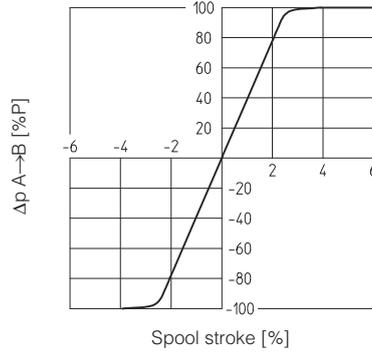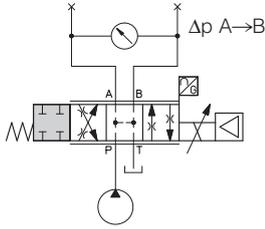
Δp A→B

Spool stroke [%]

12.4 Response time

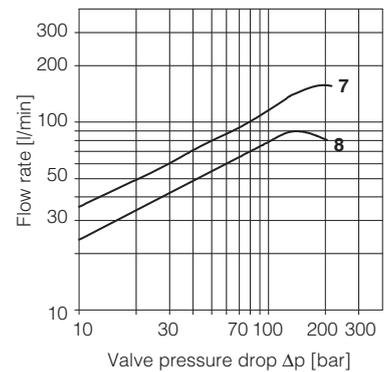The response times in below diagrams are measured at different steps of the reference input signal. They have to be considered as average values.
For valves with on-board digital driver + axis card the dynamics performances can be optimized by setting the internal software parameters.

DLHZO

Step signal [%]

0 -100
0 -75
0 -50
0 -25

Time [ms]

DLKZOR

Step signal [%]

0 -100
0 -75
0 -50
0 -25

Time [ms]
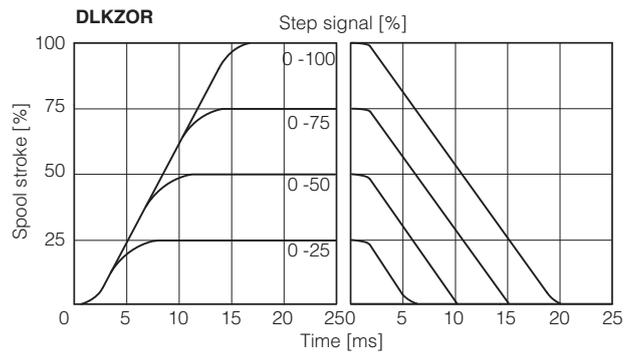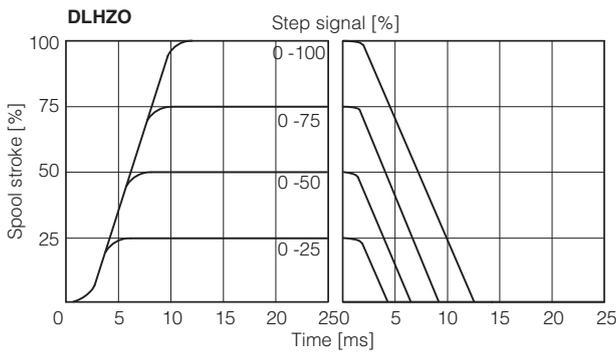
12.5 Bode diagrams

Stated at nominal hydraulic conditions

DLHZO:
1 = ± 100% nominal stroke
2 = ±   5% nominal stroke

DLKZOR:
3 = ± 100% nominal stroke
4 = ±   5% nominal stroke

FS610

AXIS & P/Q CONTROLS   **471**

13 FAIL SAFE POSITION

CONFIGURATION	LINEAR	NOT LINEAR
fail safe **1**	**t** = 7-10 ms (DLHZO) **t** = 15-20 ms (DLKZOR) mechanical stop — fail safe — regulation range	**t** = 7-10 ms (DLHZO) **t** = 15-20 ms (DLKZOR) mechanical stop — fail safe — regulation range
fail safe **3**	**t** = time required by the valve to switch from central to fail safe position at the power switch-off, with pressure 0 to 100 bar	
without fail safe	mechanical stop — regulation range	mechanical stop — regulation range

Fail safe connections		**P → A**	**P → B**	**A → T**	**B → T**
Leakage [cm³/min] at P = 100 bar **(1)**	Fail safe 1	50	70	70	50
	Fail safe 3	50	70	-	-
Flow [l/min] **(2)** DLHZO	Fail safe 3	-	-	15÷30	10÷20
DLKZOR		-	-	40÷60	25÷40

(1) Referred to spool in fail safe position and 50°C oil temperature   **(2)** Referred to spool in fail safe position at Δp = 35 bar per edge

14 HYDRAULIC OPTIONS

B = Solenoid, on-board digital driver + axis card and LVDT position transducer at side of port A.
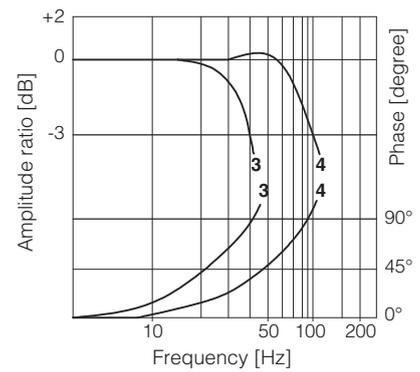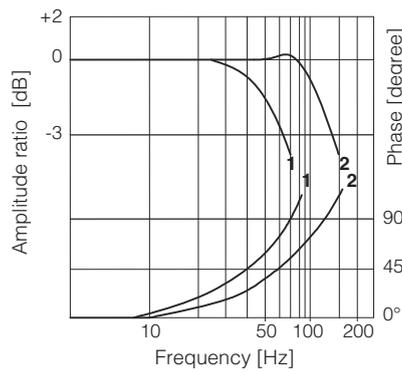For hydraulic configuration vs reference signal, see 12.1

Y = This option is mandatory if the pressure in port T exceeds 210 bar.

15 ELECTRONICS OPTIONS

I = This option provides 4 ÷ 20 mA current reference and monitor signals, instead of the standard ±10 VDC.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ±20 mA.
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.

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

16 POSSIBLE COMBINED OPTIONS

Standard versions for **D-SN**:
/BI, /BIY, /BY, /IY

Safety certified versions for **D-SN**:
/BIU, /BIUY, /BU, /BUY, /IU, /IUY, /UY
/BIK, /BIKY, /BK, /BKY, /IK, /IKY, /KY

Standard versions for **A-SN**, **A-SF**, **A-SL** and **D-SF**, **D-SL**:
/BC, /BCI, /BCIY, /BCY, /BI, /BIY, /BY,
/CI, /CIY, /CY,
/IY

Safety certified versions for **A-SN**, **A-SF**, **A-SL** and **D-SF**, **D-SL**:
/BCU, /BCIU, /BCIUY, /BCUY, /BIU, /BIUY, /BU, /BUY,
/CU, /CIU, /CIUY, /CUY, /IU, /IUY, /UY
/BCK, /BCIK, /BCIKY, /BCKY, /BIK, /BIKY, /BK, /BKY,
/CK, /CIK, /CIKY, /CKY, /IK, /IKY, /KY

17 POWER SUPPLY AND SIGNALS SPECIFICATIONS

Generic electrical output signals of the valve (e.g. fault or monitor signals) must not be directly used to activate safety functions, like to switch-ON/OFF the machine's safety components, as prescribed by the European standards (Safety requirements of fluid technology systems and components-hydraulics, ISO 4413).
For certified safety options: **/U** see tech. table **FY100** and **/K** see tech. table **FY200**

17.1 Power supply (V+ and V0)

The power supply must be appropriately stabilized or rectified and filtered: apply at least a 10000 µF/40 V capacitance to single phase rectifiers or a 4700 µF/40 V capacitance to three phase rectifiers. In case of separate power supply see 17.2.

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

17.2 Power supply for axis card logic and communication (VL+ and VL0)

The power supply for axis card logic and communication must be appropriately stabilized or rectified and filtered: apply at least a 10000 µF/40 V capacitance to single phase rectifiers or a 4700 µF/40 V capacitance to three phase rectifiers.
The separate power supply for axis card logic on pin 9 and 10, allow to remove solenoid power supply from pin 1 and 2 maintaining active the diagnostics, USB and fieldbus communications.

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

17.3 Position reference input signal (P_INPUT+)

Functionality of P_INPUT+ signal (pin 4), depends on axis card reference mode, see section 2 :

external analog reference (see 2.1): input is used as reference for control in closed loop the actuator position.
Reference input signal is factory preset according to selected valve code, defaults are ±10 V$_{DC}$ for standard and 4 ÷ 20 mA for /I option.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 V$_{DC}$ or ± 20 mA.

external fieldbus reference (see 2.1) *or automatic cycle* (see 2.2)*:* analog reference input signal can be used as on-off commands with input range 0 ÷ 24 V$_{DC}$.

17.4 Force reference input signal (F_INPUT+) - only for SF, SL

Functionality of F_INPUT+ signal (pin 7), depends on selected axis card reference mode and alternated control options, see section 3 :

SL, SF controls and external analog reference selected : input is used as reference for the axis card force closed loop.
Reference input signal is factory preset according to selected valve code, defaults are ±10 V$_{DC}$ for standard and 4 ÷ 20 mA for /I option.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 V$_{DC}$ or ± 20 mA.

SN control or fieldbus reference selected: analog reference input signal can be used as on-off commands with input range 0 ÷ 24 V$_{DC}$.

17.5 Position monitor output signal (P_MONITOR)

The axis card generates an analog output signal proportional to the actual axis position; the monitor output signal can be software set to show other signals available in the axis card (e.g. analog reference, fieldbus reference, position error, valve spool position).
Monitor output signal is factory preset according to selected valve code, defaults are ±10 V$_{DC}$ for standard and 4 ÷ 20 mA for /I option.
Output signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 V$_{DC}$ or ± 20 mA.

17.6 Force monitor output signal (F_MONITOR) - only for SF, SL

The axis card generates an analog output signal according to alternated force control option:
SN control: output signal is proportional to the actual valve spool position
SL, SF controls: output signal is proportional to the actual force applied to the cylinder's rod end
Monitor output signals can be software set to show other signals available in the axis card (e.g. analog reference, force reference).
The output range and polarity are software selectable within the maximum range ±10 V$_{DC}$ or ±20 mA.
Monitor output signal is factory preset according to selected valve code, defaults are ±10 V$_{DC}$ for standard and 4 ÷ 20 mA for /I option.
Output signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 V$_{DC}$ or ± 20 mA.

17.7 Enable input signal (ENABLE)

To enable the axis card, a 24V$_{DC}$ voltage has to be applied on pin 3.
When the Enable signal is set to zero the axis card can be software set to perform one of the following actions:
- maintain the actuator actual position in close loop control
- move towards a predefined position in closed loop control and maintains the reached position (hold position)
- move forward or backward in open loop (only the valve's closed loop remain active)

17.8 Fault output signal (FAULT)

Fault output signal indicates fault conditions of the axis card (solenoid short circuits/not connected, reference or transducer signal cable broken, maximum error exceeded, etc.). Fault presence corresponds to 0 V$_{DC}$, normal working corresponds to 24 V$_{DC}$.
Fault status is not affected by the Enable input signal.
Fault output signal can be used as digital output by software selection.

17.9 Position transducer input signal

A position transducer must be always directly connected to the axis card. Select the correct axis card execution depending on the desired transducer interface: digital SSI or Encoder (D execution), potentiometer or a generic transducer with analog interface (A execution).
Position digital input signal is factory preset to binary SSI, it can be reconfigured via software selecting between binary/gray SSI and Encoder.
Position analog input signal is factory preset according to selected valve code, defaults are ±10 V$_{DC}$ for standard and 4 ÷ 20 mA for /C option.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 V$_{DC}$ or ± 20 mA.
Refer to position transducer characteristics to select the transducer type according to specific application requirements (see 18.1).

17.10 Remote pressure/force transducer input signals - only for SF, SL

Analog remote pressure transducers or load cell can be directly connected to the axis card.
Analog input signal is factory preset according to selected valve code, defaults are ±10 V$_{DC}$ for standard and 4 ÷ 20 mA for /C option.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 V$_{DC}$ or ± 20 mA.
Refer to pressure/force transducer characteristics to select the transducer type according to specific application requirements (see 18.2).

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18 ACTUATOR'S TRANSDUCER CHARACTERISTICS

18.1 Position transducers

The accuracy of the position control is strongly dependent to the selected position transducer. Four different transducer interfaces are available on the axis cards, depending to the system requirements: potentiometer or analog signal (A execution), SSI or Encoder (D execution).
Transducers with digital interface allow high resolution and accurate measures, that combined with fieldbus communication grants highest performances.
Transducers with analog interface grant simple and cost effective solutions.

18.2 Pressure/force transducers

The accuracy of the force control is strongly dependent to the selected pressure/force transducer, see section 3 .
Alternated force controls require to install pressure transducers or load cell to measure the actual pressure/force values.
Pressure transducers allow easy system integration and cost effective solution for alternated position/force controls (see tech table **GS465** for pressure transducers details).
Load cell transducers allow the user to get high accuracy and precise regulations for alternated position/force control.
The characteristics of the remote pressure/force transducers must be always selected to match the application requirements and to obtain the best performances: transducer nominal range should be at least 115%÷120% of the maximum regulated pressure/force.

18.3 Transducers characteristics & interfaces - following values are just for reference, for details please consult the transducer's datasheet

Execution	Position				Pressure/Force
	A		D		SF, SL
Input type	Potentiometer	Analog	SSI **(3)**	Incremental Encoder	Analog
Power supply **(1)**	±10 V$_{DC}$	+24 V$_{DC}$	+5 V$_{DC}$ / +24 V$_{DC}$	+5 V$_{DC}$ / +24 V$_{DC}$	+24 V$_{DC}$
Axis card interface	±10V	0 ÷ 10V 4 ÷ 20 mA	Serial SSI binary/gray	TTL 5Vpp - 150 KHz	±10 V$_{DC}$ 4 ÷ 20 mA
Max speed	0,5 m/s	1 m/s	2 m/s	2 m/s	-
Max resolution	< 0.4 % FS	< 0.2 % FS	1 µm	1 µm (@ 0.15 m/s)	< 0.4 % FS
Linearity error **(2)**	± 0.1% FS	< ±0.03% FS	< ± 0.01 % FS	< ± 0.001 % FS	< ±0.25% FS
Repeatability **(2)**	± 0.05% FS	< ± 0.005% FS	< ± 0.001 % FS	< ± 0.001 % FS	< ±0.1% FS

(1) Power supply provided by Atos axis card **(2)** Percentage of total stroke **(3)** For Balluff BTL7 with SSI interface only special code SA433 is supported

19 ELECTRONIC CONNECTIONS

19.1 Main connector - 12 pin Ⓐ

PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
1	**V+**	Power supply 24 V$_{DC}$	Input - power supply
2	**V0**	Power supply 0 V$_{DC}$	Gnd - power supply
3	**ENABLE**	Enable (24 V$_{DC}$) or disable (0 V$_{DC}$) the axis card, referred to VL0	Input - on/off signal
4	**P_INPUT+**	Position reference input signal: ±10 V$_{DC}$ / ±20 mA maximum range	Input - analog signal **Software selectable**
5	**INPUT-**	Negative reference input signal for P_INPUT+ and F_INPUT+	Gnd - analog signal
6	**P_MONITOR**	Position monitor output signal: ±10 V$_{DC}$ / ±20 mA maximum range, referred to VL0	Output - analog signal **Software selectable**
7	**F_INPUT+**	Force reference input signal (SF, SL controls): ±10 V$_{DC}$ / ±20 mA maximum range	Input - analog signal **Software selectable**
8	**F_MONITOR**	Force (SF, SL controls) or valve spool position (SN control) monitor output signal: ±10 V$_{DC}$ / ±20mA maximum range, referred to VL0	Output - analog signal **Software selectable**
9	**VL+**	Power supply 24 V$_{DC}$ for axis card logic and communication	Input - power supply
10	**VL0** (1)	Power supply 0 V$_{DC}$ for axis card logic and communication	Gnd - power supply
11	**FAULT**	Fault (0 V$_{DC}$) or normal working (24 V$_{DC}$), referred to VL0	Output - on/off signal
PE	**EARTH**	Internally connected to axis card housing	

(1) Do not disconnect VL0 before VL+ when the axis card is connected to PC USB port

19.2 Communication connectors Ⓑ - Ⓒ

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

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

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

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

(1) Shield connection on connector's housing is recommended
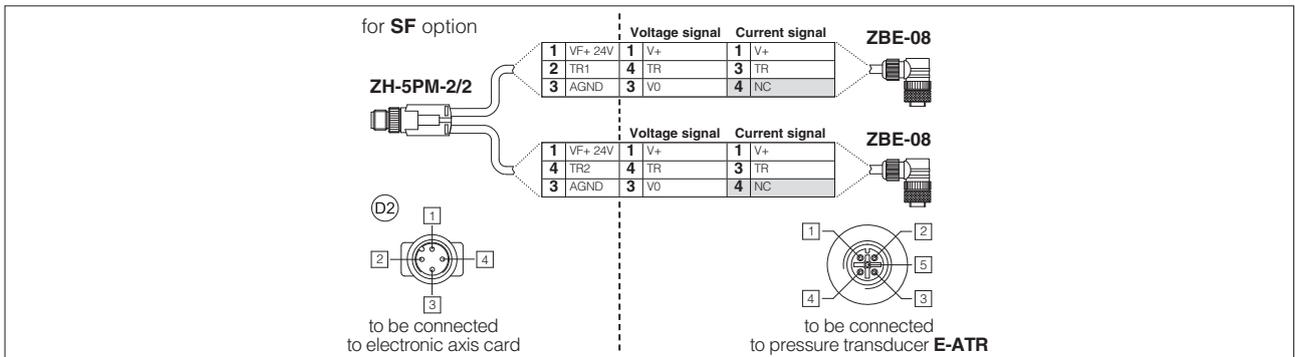
(2) Pin 2 can be fed with external +5V supply of CAN interface

19.3 Remote pressure/force transducer connector - M12 - 5 pin - only for **SF, SL**   (D)

PIN	SIGNAL	TECHNICAL SPECIFICATION	NOTES	(D1) **SL - Single transducer** (1)		(D2) **SF - Double transducers** (1)	
				Voltage	Current	Voltage	Current
1	VF +24V	Power supply +24V$_{DC}$	Output - power supply	Connect	Connect	Connect	Connect
2	TR1	1st signal transducer: ±10 V$_{DC}$ / ±20 mA maximum range	Input - analog signal **Software selectable**	Connect	Connect	Connect	Connect
3	AGND	Common gnd for transducer power and signals	Common gnd	Connect	/	Connect	/
4	TR2	2nd signal transducer: ±10 V$_{DC}$ / ±20 mA maximum range	Input - analog signal **Software selectable**	/	/	Connect	Connect
5	NC	Not connect		/	/	/	/

(1) Single/double transducer configuration is software selectable

Remote pressure transducers connection - example
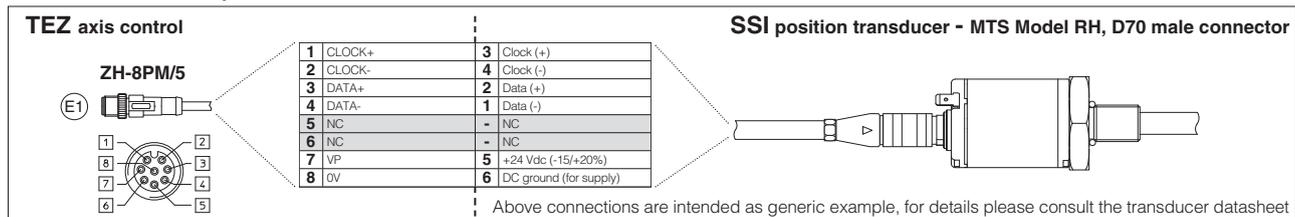

Note: pin layout always referred to axis card view

19.4 D execution - Digital position transducers connector - M12 - 8 pin   (E1)

|	SSI - default transducer (1)			Encoder (1)		
PIN	SIGNAL	TECHNICAL SPECIFICATION	NOTES	SIGNAL	TECHNICAL SPECIFICATION	NOTES
1	**CLOCK+**	Serial syncronous clock (+)	Input - digital signal	R	Input channel R	Input - digital signal
2	**CLOCK-**	Serial syncronous clock (-)		/R	Input channel /R	
3	**DATA+**	Serial position data (+)		A	Input channel A	
4	**DATA-**	Serial position data (-)		/A	Input channel /A	
5	**NC**	Not connect	Do not connect	B	Input channel B	
6	**NC**			/B	Input channel /B	
7	**VP**	Power supply: +24V$_{DC}$, +5V$_{DC}$ or OFF (default OFF)	Output - power supply **Software selectable**	VP	Power supply: +24V$_{DC}$, +5V$_{DC}$ or OFF (default OFF)	Output - power supply **Software selectable**
8	**0 V**	Common gnd for transducer power and signals	Common gnd	0 V	Common gnd for transducer power and signals	Common gnd

(1) Digital position transducer type is software selectable: Encoder or SSI, see 17.9

SSI connection - example

Note: pin layout referred to axis card view

Encoder connection - example
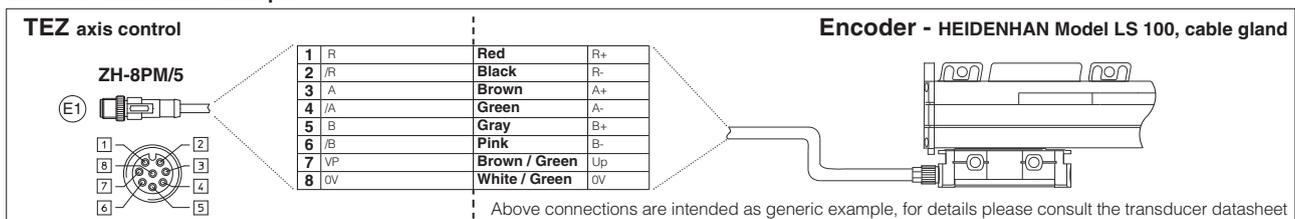
Note: pin layout referred to axis card view

19.5 A execution - Analog position transducers connector - M12 - 5 pin   (E2)

PIN	SIGNAL	TECHNICAL SPECIFICATION	NOTES	Potentiometer	Analog
1	VP +24V	Power supply: +24V$_{DC}$ or OFF (default OFF)	Output - power supply **Software selectable**	/	Connect
2	VP +10V	Power supply reference +10V$_{DC}$ (always present)	Output - power supply	Connect	/
3	AGND	Common gnd for transducer power and signals	Common gnd	Connect	Connect
4	TR	Signal transducer	Input - analog signal	Connect	Connect
5	VP -10V	Power supply reference -10V$_{DC}$ (always present)	Output - power supply	Connect	/

Note: analog input range is software selectable, see 17.9

FS610   AXIS & P/Q CONTROLS   **475**

19.6 TEZ connections layout

MAIN CONNECTORS

ZM-12P - 12 pin - metallic **(1)**
Ø 28 ~ 93 PG13.5 A2

ZH-12P - 12 pin - plastic
Ø 29 ~ 100 PG16 A4

male - 12 pin **(2)**

PLASTIC PROTECTION CAPS - supplied with the valves

Pressure/Force transducers cap
Ø14 D1 D2 13.5

USB cap
Ø14 B 13.5

Position transducers cap
Ø14 E1 E2 13.5

Tightening torque: 0,6 Nm

DO NOT REMOVE

FIELDBUS CONNECTORS

ZM-5PF
C1 Ø 20 ~ 58

CANopen C1
female **(2)**

CANopen C2
male **(2)**

ZM-5PM
Ø 20 ~ 62 C2

ZM-5PF/BP
C1 Ø 20 ~ 58

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

PROFIBUS DP C1
female **(2)**

PROFIBUS DP C2
male **(2)**

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

ZM-5PM/BP
Ø 20 ~ 62 C2

ZM-4PM/E
C1 Ø 20 ~ 58

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

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

ZM-4PM/E
Ø 20 ~ 58 C2

TRANSDUCERS AND USB CONNECTORS

ZH-5PM/1.5 or **ZH-5PM/5**
SINGLE FORCE TRANSDUCER CABLE - **SL**
cable lenght 1,5m or 5m
D1 Ø 15 ~ 50

Pressure/Force transducers
D1 D2
male **(2)**

ZH-5PM-2/2
DOUBLE PRESSURE TRANSDUCERS CABLE - **SF**
cable lenght 2m
D2 Ø 15 Ø 20 ~ 50

USB B
male **(2)**

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

ZH-8PM/5
DIGITAL POSITION TRANSDUCER CABLE - **D**
cable lenght 5m
E1 Ø 15 ~ 50

Digital position transducer (SSI or Encoder)
E1
male **(2)**

ZH-5PM/1.5 or **ZH-5PM/5**
ANALOG POSITION TRANSDUCERS CABLE - **A**
cable lenght 1,5m or 5m
E2 Ø 15 ~ 50

Analog position transducer
E2
male **(2)**

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

19.7 Diagnostic LEDs (L)

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

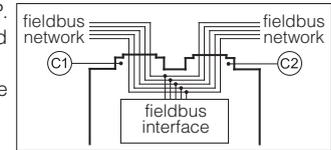| FIELDBUS / LEDS	NP Not Present	BC CANopen	BP PROFIBUS DP	EH EtherCAT	EW POWERLINK	EI EtherNet/IP	EP PROFINET
L1	VALVE STATUS			LINK/ACT			
L2	NETWORK STATUS			NETWORK STATUS			
L3	SOLENOID STATUS			LINK/ACT			

L1 L2 L3

20 IN / OUT FIELDBUS COMMUNICATION CONNECTORS

Two fieldbus communication connectors are always available for digital axis card executions BC, BP, EH, EW, EI, EP. This features allows considerable technical advantages in terms of installation simplicity, wirings reduction and also avoid the usage expensive T-connectors.

For BC and BP executions the fieldbus connectors have an internal pass-through connection and can be used like end point of the fieldbus network, using an external terminator (see tech table **GS500**).

For EH, EW, EI and EP execution the external terminators are not required: each connector is internally terminated.

BC and BP pass-through connection

21 CONNECTORS CHARACTERISTICS - to be ordered separately

21.1 Main connectors

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

21.2 Fieldbus communication connectors

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

(1) E-TRM-** terminators can be ordered separately, see tech table **GS500**   **(2)** Internally terminated

21.3 Pressure/Force transducer connectors - only for **SF, SL**

CONNECTOR TYPE	SL - Single transducer		SF - Double transducers
CODE	(D1) ZH-5PM/1.5	(D1) ZH-5PM/5	(D2) ZH-5PM-2/2
Type	5 pin male straight circular		4 pin male straight circular
Standard	M12 coding A – IEC 61076-2-101		M12 coding A – IEC 61076-2-101
Material	Plastic		Plastic
Cable gland	Connector moulded on cables 1,5 m lenght / 5 m lenght		Connector moulded on cables 2 m lenght
Cable	5 x 0,25 mm²		3 x 0,25 mm² (both cables)
Connection type	molded cable		splitting cable
Protection (EN 60529)	IP 67		IP 67

21.4 Position transducer connectors

CONNECTOR TYPE	DIGITAL POSITION TRANSDUCER D execution - see 19.4	ANALOG POSITION TRANSDUCER A execution - see 19.5	
CODE	(E1) ZH-8PM/5	(E2) ZH-5PM/1.5	(E2) ZH-5PM/5
Type	8 pin male straight circular	5 pin male straight circular	
Standard	M12 coding A – IEC 61076-2-101	M12 coding A – IEC 61076-2-101	
Material	Plastic	Plastic	
Cable gland	Connector moulded on cables 5 m lenght	Connector moulded on cables 1,5 m lenght / 5 m lenght	
Cable	8 x 0,25 mm²	5 x 0,25 mm²	
Connection type	molded cable	molded cable	
Protection (EN 60529)	IP 67	IP 67	

22 MAIN SOFTWARE PARAMETER SETTINGS

For a detailed descriptions of the available settings, wirings and installation procedures, please refer to the user manuals included in the Z-SW programming software:
Z-MAN-RI-LEZ   - user manual for **TEZ** and **LEZ** with **SN**
Z-MAN-RI-LEZ-S - user manual for **TEZ** and **LEZ** with **SF**, **SL**

22.1 External reference and transducer parameters
Allow to configure the axis card reference and transducer inputs, analog or digital, to match the specific application requirements:
- *Scaling parameters*   define the correspondence of these signals with the specific actuator stroke or force to be controlled
- *Limit parameters*   define maximum/minimum stroke and force to detect possible alarm conditions
- *Homing parameters*   define the startup procedure to initialize incremental transducer (e.g. Encoder)

22.2 PID control dynamics parameters
Allow to optimize and adapt the axis card closed loop to the wide range of hydraulic system characteristics:
- *PID parameters*   each part of the closed loop algorithm (proportional, integral, derivative, feed forward, fine positioning, etc) can be modified to match the application requirements

22.3 Monitoring parameters
Allow to configure the axis card monitoring function of the positioning error (difference between actual reference and feedback) and detects anomalous conditions:
- *Monitoring parameters*   maximum allowed errors can be set for both static and dynamic positioning phases, and dedicated waiting times can be set to delay the activation of the alarm condition and relevant reaction (see 22.4)

22.4 Fault parameters
Allow to configure how the axis card detect and react to alarm conditions:
- *Diagnostics parameters*   define different conditions, threshold and delay time to detect alarm conditions
- *Reaction parameters*   define different actions to be performed in case of alarm presence (stop at actual or preprogrammed position, emergency forward/backward, axis card disabling, etc.)

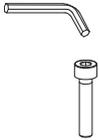### 22.5 Valve characteristics compensation
Allow to modify the valve regulation to match the actuator/system characteristics and to obtain the best overall performances:
- *Valve parameters*   modify the standard valve regulation by means of deadband compensation, curve linearization and differentiated gain for positive and negative regulation

22.6 Motion phases parameters
When the internal reference generation is active a pre-programmed cycle can be generated; start/stop/switch-over commands and reference generation types parameters can be set to design a customized sequence of motion phases adapted to the specific application requirements (see 2.2).

23 FASTENING BOLTS AND SEALS

	DLHZO	DLKZOR
	Fastening bolts: 4 socket head screws M5x50 class 12.9 Tightening torque = 8 Nm	**Fastening bolts:** 4 socket head screws M6x40 class 12.9 Tightening torque = 15 Nm
	Seals: 4 OR 108; Diameter of ports A, B, P, T: Ø 7,5 mm (max) 1 OR 2025 Diameter of port Y: Ø = 3,2 mm (only for /Y option)	**Seals:** 5 OR 2050; Diameter of ports A, B, P, T: Ø 11,2 mm (max) 1 OR 108 Diameter of port Y: Ø = 5 mm (only for /Y option)

24 INSTALLATION DIMENSIONS [mm]

DLHZO-TEZ

ISO 4401: 2005
Mounting surface: 4401-03-02-0-05 (see table P005)
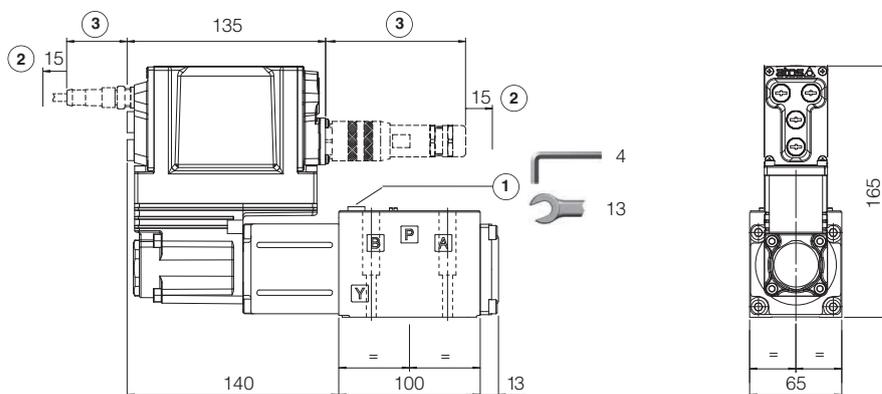**(for /Y surface 4401-03-03-0-05 without X port)**

Mass [kg]	
DLHZO	2,3
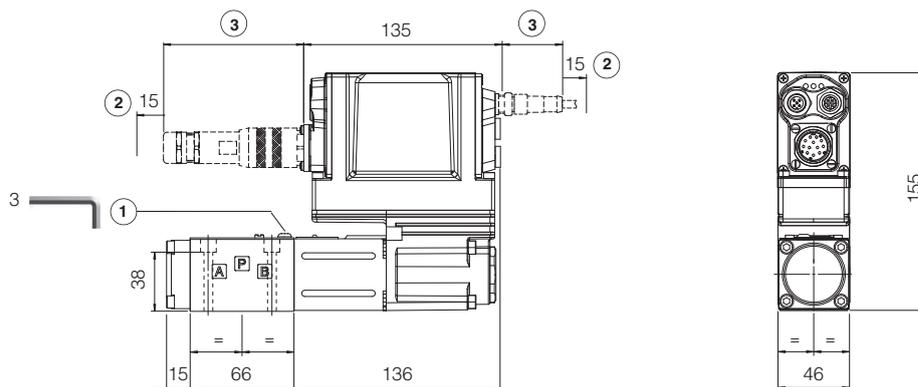
DLKZOR-TEZ

ISO 4401: 2005
Mounting surface: 4401-05-04-0-05 (see table P005)
(for /Y surface 4401-05-05-0-05 without X port)

Mass [kg]	
DLKZOR	4,3

① = Air bleeding

② = Space to remove the connectors

③ = The dimensions of all connectors must be considered, see section 19.6

Note: for option /B the proportional solenoid, the LVDT transducer and the on-board digital driver + axis card are at side of port A
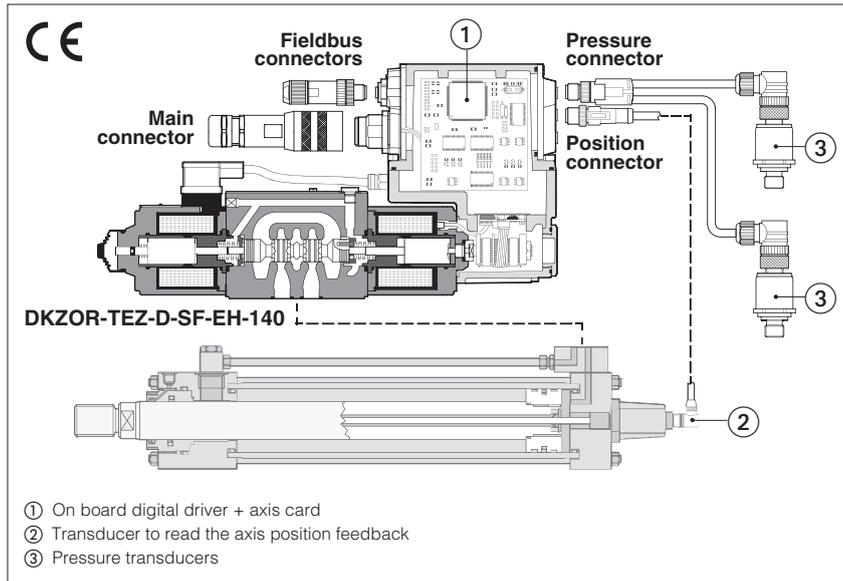
25 RELATED DOCUMENTATION

FS001	Basics for digital electrohydraulics	**GS510**	Fieldbus
FS900	Operating and maintenance information for proportional valves	**K800**	Electric and electronic connectors
FY100	Safety proportional valves - option /U	**P005**	Mounting surfaces for electrohydraulic valves
FY200	Safety proportional valves - option /K	**Y010**	Basics for safety components
GS500	Programming tools		

atos

Digital servoproportionals with on-board axis card

direct, double solenoid, with LVDT transducer and zero spool overlap

CE

Fieldbus connectors ①
Pressure connector
Main connector
Position connector

③
③

DKZOR-TEZ-D-SF-EH-140

②

① On board digital driver + axis card
② Transducer to read the axis position feedback
③ Pressure transducers

DHZO-TEZ, DKZOR-TEZ

Digital servoproportional directional valves, direct, double solenoid, with on-board digital driver + axis card, LVDT position transducer and zero spool overlap for position closed loop controls of linear or rotative hydraulic actuator. The double solenoid execution grants larger flow capacity and central safety rest position.

The controlled actuator has to be equipped with transducer (analog, potentiometer, SSI or Encoder) to read the axis position feedback.

The valve can be operated via an external reference signal or automatic cycle, see section ②.

Alternated P/Q controls option, see ③ :
SF, **SL** = alternated force control added to the basic position one

Safety options TÜV certified, see ⑦ :
U = safe double power supply
K = safe on/off signals

DHZO:	DKZOR:
Size: **06** -ISO 4401	Size: **10** -ISO 4401
Max flow: **80 l/min**	Max flow: **180 l/min**
Max pressure: **350 bar**	Max pressure: **315 bar**

---

1 MODEL CODE

DHZO	-	TEZ	-	D	-	SN	-	NP	-	0	70	-	L	5	/	*		*	/	*

Servoproportional directional valves, direct
DHZO = size 06
DKZOR = size 10

TEZ = on-board digital driver + axis card, one LVDT transducer

Position transducer type:
A = Analog (standard, potentiometer)
D = Digital (SSI, Encoder)

Alternated P/Q controls:
SN = none
SF = force control (2 pressure transducers)
SL = force control (1 load cell)

Fieldbus interface, USB port always present:
NP = Not Present
BC = CANopen   **EW** = POWERLINK
BP = PROFIBUS DP   **EI** = EtherNet/IP
EH = EtherCAT   **EP** = PROFINET RT/IRT

Valve size ISO 4401:
0 = 06   **1** = 10

Configuration:

Standard	Option **/B**
70 =	

(1) For possible combined options, see section ⑮

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

Series number

Hydraulic options (1):
B = solenoid with on-board digital driver + axis card and LVDT transducer at side of port A
Y = external drain

Electronics options (1):
C = current feedback for pressure transducer 4÷20mA (omit for std voltage ±10VDC) - only for **SF, SL**
I = current reference input and monitor 4÷20mA (omit for std voltage ±10VDC)

Safety options TÜV certified **(1)**:
U = safe double power supply
K = safe on/off signals
See section ⑦

SAFETY CERTIFIED

Spool size:

	3 (L)	**5** (L,D)
DHZO	= 17	28
DKZOR	= 45	75

Nominal flow (l/min) at Δp 10bar P-T

Spool type - regulating characteristics:

L = linear

D = differential-progressive
P-A = Q,   B-T = Q/2
P-B = Q/2, A-T = Q

2 POSITION CONTROL

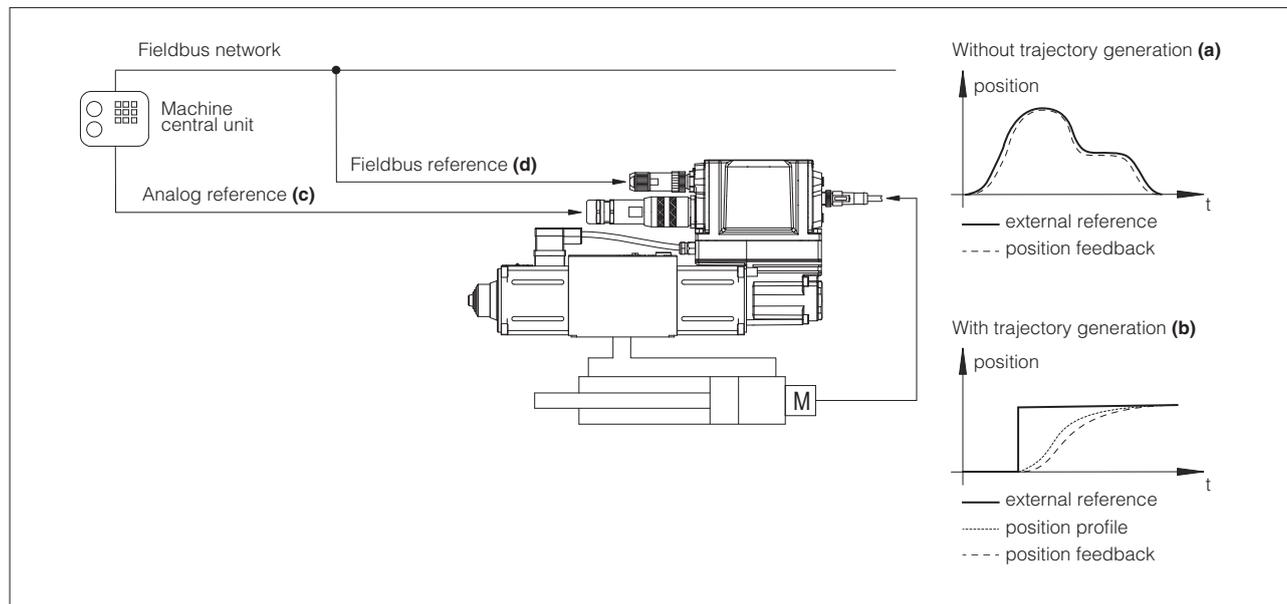### 2.1 External reference signal

Axis card controls in closed loop the actuator position according to a reference signal from the machine central unit.

Position profile can be managed in two ways (software selectable):
- Without trajectory generation **(a)**: the axis card receives from the machine central unit the reference signal and follows it at any given instant
- With trajectory generation **(b)**: the axis card receives from the machine central unit just the final target position and internally generates a position profile limiting acceleration, velocity and deceleration

The reference signal can be software selected between Analog reference **(c)** and Fieldbus reference **(d)**.
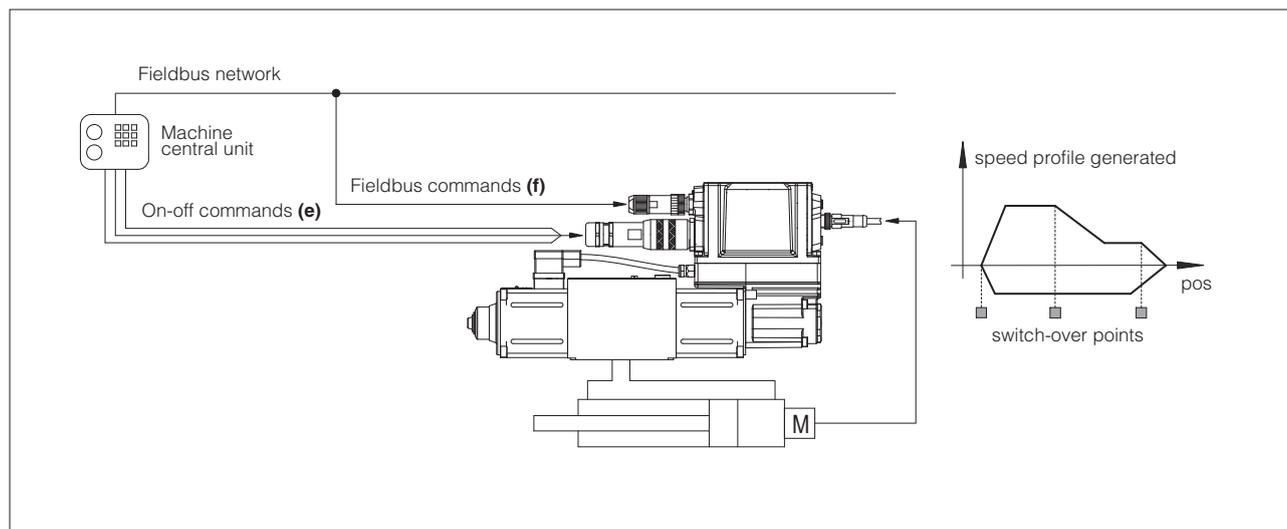
Refer to the axis card user manual for further details on position control features.

2.2 Automatic cycle

Axis card controls in closed loop the actuator position according to an internally generated automatic cycle: only start, stop and switch-over commands are required from the machine electronic central unit by means On-off commands **(e)** or Fieldbus commands **(f)**.

Atos PC software allows to realize an automatic cycle according to the application requirements. Refer to the axis card user manual for further details on automatic cycle features.
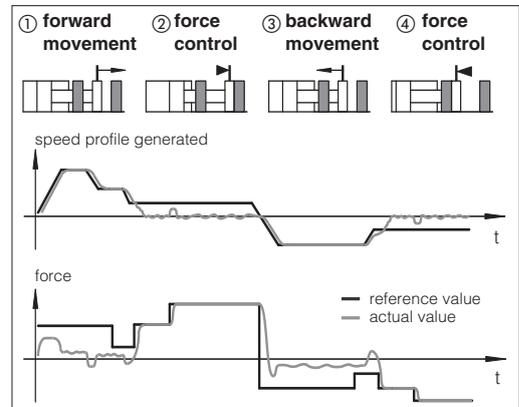
3 ALTERNATED POSITION / FORCE CONTROL

SF and **SL** controls add the alternated force closed loop control to the actuator stan-
dard position control. Pressure or force remote transducers have to be installed on
the actuator and interfaced to the valve, see below functional schemes.

The position/force controls are operated according to two separate reference signals
and a dedicated algorithm automatically selects which control is active time by time.

The dynamics of the switching between the two controls can be regulated thanks to
specific software setting, in order to avoid instability and vibrations.

Position control is active (see phase ① and ③ at side) when the actuator force is
lower than the relevant reference signal - the valve controls the actuator position by
closed-loop regulation.

Force control is active (see phase ② and ④ at side) when the actuator actual force,
measured by remote transducers, grows up to the relevant reference signal - the axis
card reduces the valve's regulation in order to limit the actuator force; if the force
tends to decrease under its reference signal, the position control returns active.

Alternated control configurations

SF	SL
two remote pressure transducers have to be installed on the actuator's ports; the actuator force is calculated by the pressure feedbacks (Pa - Pb)	one load cell transducer has to be installed between the actuator and the controlled load

T	valve spool transducer	M	actuator position transducer	P	pressure transducer	L	load cell

SF – position/force control
Adds force control to standard position control and permits to limit the max force in two directions controlling in closed loop the delta pressure acting on
both sides of the hydraulic actuator. Two pressure transducers have to be installed on A and B hydraulic lines.

SL – position/force control
Adds force control to standard position control and permits to limit the max force in one or two directions controlling in closed loop the force performed
by the hydraulic actuator. A load cell has to be installed on the hydraulic actuator.

General Notes:
- auxiliary check valves are recommended in case of specific hydraulic configuration requirements in absence of power supply or fault
- Atos technical office is available for additional evaluations related to specific applications

4 **GENERAL NOTES**

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

5 **VALVE SETTINGS AND PROGRAMMING TOOLS**

Valve's functional parameters and configurations, can be easily set and optimized using Atos Z-SW programming software connected via USB port to the digital axis card (see table **FS900**). For fieldbus versions, the software permits valve's parameterization through USB port also if the axis card is connected to the central machine unit via fieldbus.
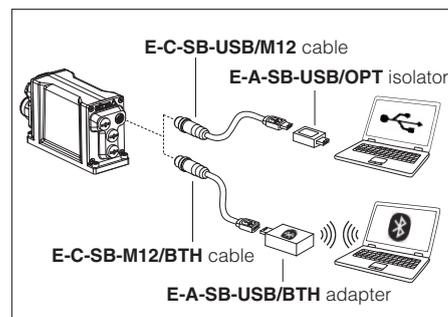
Z-SW-FULL   support: NP (USB)   PS (Serial)
                          BC (CANopen)   BP (PROFIBUS DP)   EH (EtherCAT)
                          EW (POWERLINK) EI (EtherNet/IP)   EP (PROFINET)

Note: Z-SW programming software supports valves with option SF, SL for alternated control

⚠ **WARNING: axis card USB port is not isolated!** For E-C-SB-USB/M12 cable, the use of isolator adapter is highly recommended for PC protection (see tech table **GS500**)

⚠ **WARNING:** see tech table **GS500** for the list of countries where the Bluetooth adapter has been approved

USB or Bluetooth connection

E-C-SB-USB/M12 cable
E-A-SB-USB/OPT isolator
E-C-SB-M12/BTH cable
E-A-SB-USB/BTH adapter

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

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

7 **SAFETY OPTIONS**

Atos range of proportional directional valves, provides functional safety options **/U** and **/K** , designed to accomplish a safety function, intended to reduce the risk in process control systems.

They are **TÜV certified** in compliance to **IEC 61508 up to SIL 3 and ISO 13849 up to category 4, PL e**

SAFETY CERTIFIED
TÜV SÜD

Safe double power supply, option **/U**: the axis card has separate power supplies for logic and solenoids. The safe condition is reached by cutting the electrical supply to solenoids, while electronics remains active for monitoring functions and fieldbus communication, see tech table **FY100**

Safety function via on/off signals, option **/K**: upon a disable command, the axis card checks the spool position and it provides an on/off acknowledgement signal only when the valve is in safe condition, see tech table **FY200**

8 **GENERAL CHARACTERISTICS**

Assembly position	Any position		
Subplate surface finishing to ISO 4401	Acceptable roughness index: Ra ≤0,8, recommended Ra 0,4 – Flatness ratio 0,01/100		
MTTFd valves according to EN ISO 13849	150 years, see technical table P007		
Ambient temperature range	**Standard** = -20°C ÷ +60°C	**/PE** option = -20°C ÷ +60°C	**/BT** option = -40°C ÷ +60°C
Storage temperature range	**Standard** = -20°C ÷ +70°C	**/PE** option = -20°C ÷ +70°C	**/BT** option = -40°C ÷ +70°C
Surface protection	Zinc coating with black passivation, galvanic treatment (axis card housing)		
Corrosion resistance	Salt spray test (EN ISO 9227) > 200 h		
Compliance	CE according to EMC directive 2014/30/EU (Immunity: EN 61000-6-2; Emission: EN 61000-6-3) RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006		

9 **HYDRAULIC CHARACTERISTICS** - based on mineral oil ISO VG 46 at 50 °C

Valve model	DHZO			DKZOR		
Pressure limits [bar]	ports **P**, **A**, **B** = 350; **T** = 210 (250 with external drain /Y) **Y** = 10			ports **P**, **A**, **B** = 315; **T** = 210 (250 with external drain /Y) **Y** = 10		
Spool type	**L3**	**L5**	**D5**	**L3**	**L5**	**D5**
Nominal flow Δp P-T [l/min] **(1)** Δp= 10 bar	18	28	28	45	75	75
Δp= 30 bar	30	50	50	80	130	130
Δp= 70 bar	45	75	75	120	170	170
Max permissible flow **(2)**	50	80	80	130	180	180
Leakage [cm³/min]	<500 (at p = 100 bar); <1500 (at p = 350 bar)			<800 (at p = 100 bar); <2500 (at p = 315 bar)		
Response time **(3)** [ms]	≤ 15			≤ 20		
Hysteresis	≤ 0,2 [% of max regulation]					
Repeatability	± 0,1 [% of max regulation]					
Thermal drift	zero point displacement < 1% at ΔT = 40°C					

(1) For different Δp, the max flow is in accordance to the diagrams in section 12.2
(2) See detailed diagrams in section 12.3
(3) 0-100% step signal

10 ELECTRICAL CHARACTERISTICS

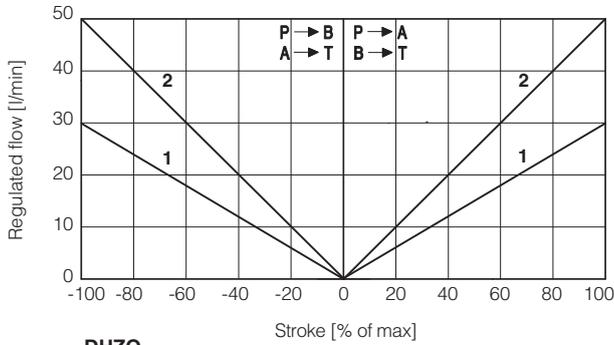|	
Power supplies	Nominal : +24 V$_{DC}$ Rectified and filtered : V$_{RMS}$ = 20 ÷ 32 V$_{MAX}$ (ripple max 10 % V$_{PP}$)
Max power consumption	50 W
Max. solenoid current	**DHZO** = 2,6 A **DKZOR** = 3 A
Coil resistance R at 20°C	**DHZO** = 3 ÷ 3,3 Ω **DKZOR** = 3,8 ÷ 4,1 Ω
Analog input signals	Voltage: range ±10 V$_{DC}$ (24 V$_{MAX}$ tollerant) Input impedance: Ri > 50 kΩ Current: range ±20 mA Input impedance: Ri = 500 Ω
Monitor outputs	Output range: voltage ±10 V$_{DC}$ @ max 5 mA current ±20 mA @ max 500 Ω load resistance
Enable input	Range: 0 ÷ 5 V$_{DC}$ (OFF state), 9 ÷ 24 V$_{DC}$ (ON state), 5 ÷ 9 V$_{DC}$ (not accepted); Input impedance: Ri > 10 kΩ
Fault output	Output range: 0 ÷ 24 V$_{DC}$ (ON state > [power supply - 2 V] ; OFF state < 1 V) @ max 50 mA; external negative voltage not allowed (e.g. due to inductive loads)
Position transducers power supply	+24 V$_{DC}$ @ max 100 mA and +5 V$_{DC}$ @ max 100 mA are software selectable; ±10 V$_{DC}$ @ max 14 mA minimum load resistance 700 Ω
Pressure/Force transducer power supply (only for SF, SL)	+24V$_{DC}$ @ max 100 mA (E-ATR-8 see tech table **GS465**)
Alarms	Solenoid not connected/short circuit, cable break with current reference signal, over/under temperature, valve spool transducer malfunctions, alarms history storage function
Insulation class	H (180°) Due to the occuring surface temperatures of the solenoid coils, the European standards ISO 13732-1 and EN982 must be taken into account
Protection degree to DIN EN60529	IP66 / IP67 with mating connectors
Duty factor	Continuous rating (ED=100%)
Tropicalization	Tropical coating on electronics PCB
Additional characteristics	Short circuit protection of solenoid's current supply; 3 leds for diagnostic; protection against reverse polarity of power supply
Electromagnetic compatibility (EMC)	According to Directive 2014/30/UE (Immunity: EN 61000-6-2; Emission: EN 61000-6-3)
Communication interface	USB Atos ASCII coding	CANopen EN50325-4 + DS408	PROFIBUS DP EN50170-2/IEC61158	EtherCAT, POWERLINK, EtherNet/IP, PROFINET IO RT / IRT EC 61158
Communication physical layer	not insulated USB 2.0 + USB OTG	optical insulated CAN ISO11898	optical insulated RS485	Fast Ethernet, insulated 100 Base TX
Recommended wiring cable	LiYCY shielded cables, see section [20]

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

11 SEALS AND HYDRAULIC FLUIDS - for other fluids not included in below table, consult our technical office
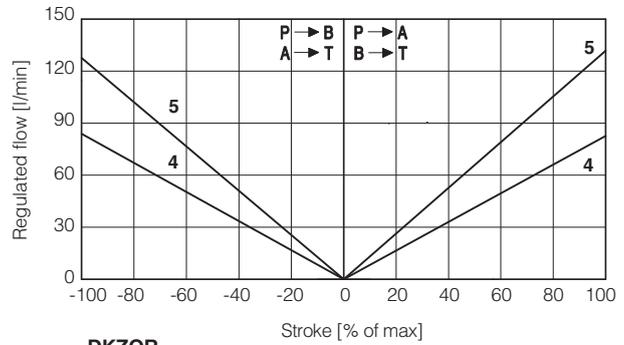
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	20÷100 mm²/s - max allowed range 15 ÷ 380 mm²/s
Max fluid contamination level normal operation	ISO4406 class 18/16/13 NAS1638 class 7 see also filter section at
longer life	ISO4406 class 16/14/11 NAS1638 class 5 www.atos.com or KTF catalog

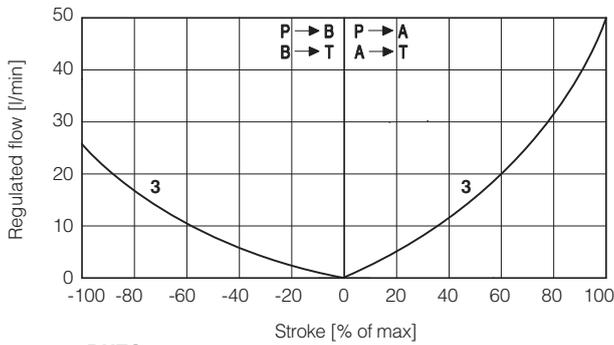| Hydraulic fluid	Suitable seals type	Classification	Ref. Standard
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

12 DIAGRAMS - based on mineral oil ISO VG 46 at 50 °C
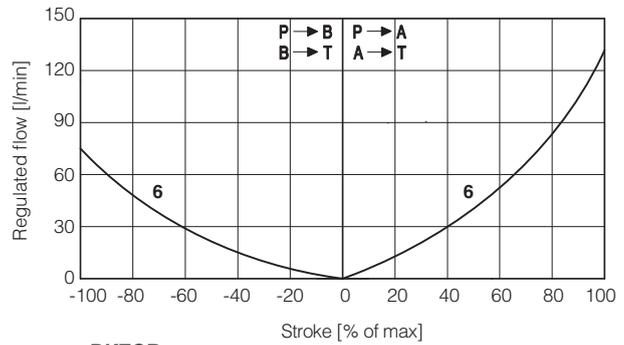
12.1 Regulation diagrams (values measure at Δp 30 bar P-T)

DHZO
1 = L3 **2** = L5

DKZOR
4 = L3 **5** = L5

DHZO
3 = D5

DKZOR
6 = D5

Note:

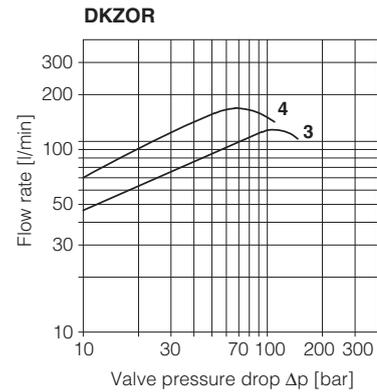Hydraulic configuration vs. reference signal for configurations 70 (standard and option /B)

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

12.2 Flow /Δp diagrams
stated at 100% of valve stroke

DHZO
1 = spool L3,
2 = spool L5, D5

DKZOR
3 = spool L3
4 = spool L5, D5
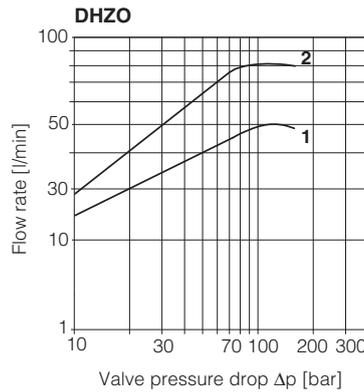
12.3 Operating limits

DHZO
1 = spool L3
2 = spool L5, D5
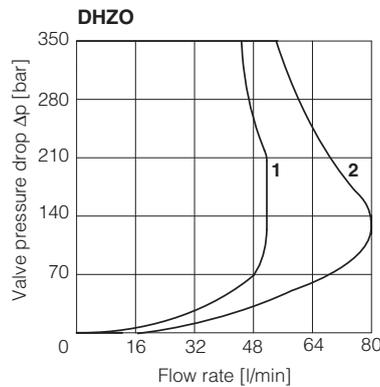
DKZOR
3 = spool L3
4 = spool L5, D5

12.4 Response time

The response times in below diagrams are measured at different steps of the reference input signal. They have to be considered as average values.
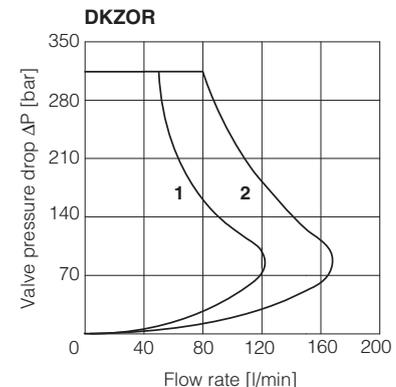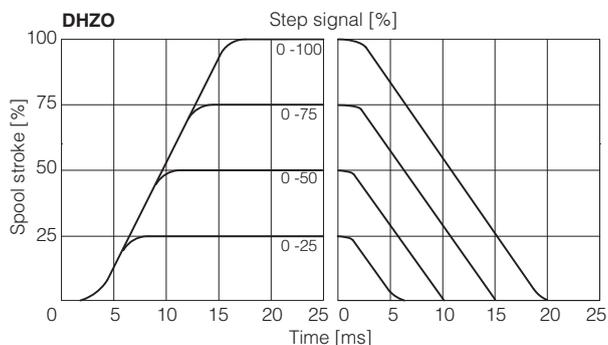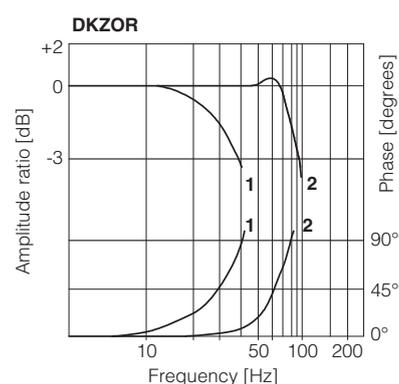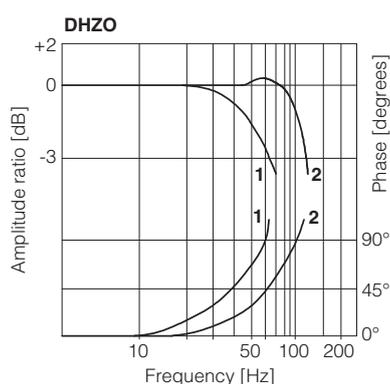For valves with on-board digital driver + axis card the dynamics performances can be optimized by setting the internal software parameters.
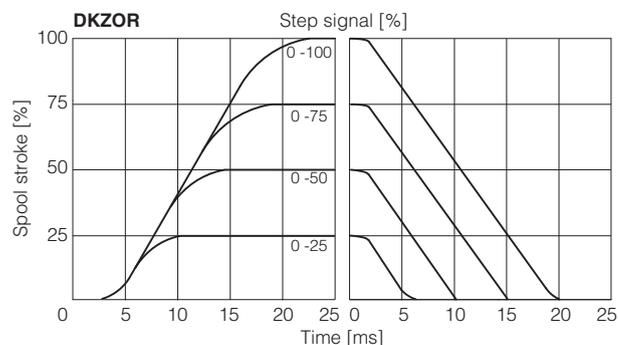
12.5 Bode diagrams

1 = 10% ⟷ 90% nominal stroke
2 = 50% ± 5% nominal stroke

| **13** | **HYDRAULIC OPTIONS** |

B = Solenoid, on-board digital driver + axis card and LVDT position transducer at side of port A.
For hydraulic configuration vs reference signal, see 12.1

Y = This option is mandatory if the pressure in port T exceeds 210 bar.

| **14** | **ELECTRONICS OPTIONS** |

I = This option provides 4 ÷ 20 mA current reference and monitor signals, instead of the standard ±10 VDC.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ±20 mA.
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.

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

| **15** | **POSSIBLE COMBINED OPTIONS** |

Standard versions for **D-SN**:
/BI, /BIY, /BY, /IY

Safety certified versions for **D-SN**:
/BIU, /BIUY, /BU, /BUY, /IU, /IUY, /UY
/BIK, /BIKY, /BK, /BKY, /IK, /IKY, /KY

Standard versions for **A-SN**, **A-SF**, **A-SL** and **D-SF**, **D-SL**:
/BC, /BCI, /BCIY, /BCY, /BI, /BIY, /BY,
/CI, /CIY, /CY,
/IY

Safety certified versions for **A-SN**, **A-SF**, **A-SL** and **D-SF**, **D-SL**:
/BCU, /BCIU, /BCIUY, /BCUY, /BIU, /BIUY, /BU, /BUY,
/CU, /CIU, /CIUY, /CUY, /IU, /IUY, /UY
/BCK, /BCIK, /BCIKY, /BCKY, /BIK, /BIKY, /BK, /BKY,
/CK, /CIK, /CIKY, /CKY, /IK, /IKY, /KY

FS620   *AXIS & P/Q CONTROLS*   **487**

16 POWER SUPPLY AND SIGNALS SPECIFICATIONS

Generic electrical output signals of the valve (e.g. fault or monitor signals) must not be directly used to activate safety functions, like to switch-ON/OFF the machine's safety components, as prescribed by the European standards (Safety requirements of fluid technology systems and components-hydraulics, ISO 4413).
For certified safety options: **/U** see tech. table **FY100** and **/K** see tech. table **FY200**

16.1 Power supply (V+ and V0)

The power supply must be appropriately stabilized or rectified and filtered: apply at least a 10000 µF/40 V capacitance to single phase rectifiers or a 4700 µF/40 V capacitance to three phase rectifiers. In case of separate power supply see 16.2.

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

16.2 Power supply for axis card logic and communication (VL+ and VL0)

The power supply for axis card logic and communication must be appropriately stabilized or rectified and filtered: apply at least a 10000 µF/40 V capacitance to single phase rectifiers or a 4700 µF/40 V capacitance to three phase rectifiers.
The separate power supply for axis card logic on pin 9 and 10, allow to remove solenoid power supply from pin 1 and 2 maintaining active the diagnostics, USB and fieldbus communications.

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

16.3 Position reference input signal (P_INPUT+)

Functionality of P_INPUT+ signal (pin 4), depends on axis card reference mode, see section 2 :

external analog reference (see 2.1): input is used as reference for control in closed loop the actuator position.
Reference input signal is factory preset according to selected valve code, defaults are ±10 VDC for standard and 4 ÷ 20 mA for /I option.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.

external fieldbus reference (see 2.1) *or automatic cycle* (see 2.2)*:* analog reference input signal can be used as on-off commands with input range 0 ÷ 24 VDC.

16.4 Force reference input signal (F_INPUT+) - only for **SF, SL**

Functionality of F_INPUT+ signal (pin 7), depends on selected axis card reference mode and alternated control options, see section 3 :

SL, SF controls and external analog reference selected : input is used as reference for the axis card force closed loop.
Reference input signal is factory preset according to selected valve code, defaults are ±10 VDC for standard and 4 ÷ 20 mA for /I option.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.

SN control or fieldbus reference selected: analog reference input signal can be used as on-off commands with input range 0 ÷ 24VDC.

16.5 Position monitor output signal (P_MONITOR)

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

16.6 Force monitor output signal (F_MONITOR) - only for **SF, SL**

The axis card generates an analog output signal according to alternated force control option:
SN control: output signal is proportional to the actual valve spool position
SL, SF controls: output signal is proportional to the actual force applied to the cylinder's rod end
Monitor output signals can be software set to show other signals available in the axis card (e.g. analog reference, force reference).
The output range and polarity are software selectable within the maximum range ±10 VDC or ±20 mA.
Monitor output signal is factory preset according to selected valve code, defaults are ±10 VDC for standard and 4 ÷ 20 mA for /I option.
Output signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.

16.7 Enable input signal (ENABLE)

To enable the axis card, a 24VDC voltage has to be applied on pin 3.
When the Enable signal is set to zero the axis card can be software set to perform one of the following actions:
- maintain the actuator actual position in close loop control
- move towards a predefined position in closed loop control and maintains the reached position (hold position)
- move forward or backward in open loop (only the valve's closed loop remain active)

16.8 Fault output signal (FAULT)

Fault output signal indicates fault conditions of the axis card (solenoid short circuits/not connected, reference or transducer signal cable broken, maximum error exceeded, etc.). Fault presence corresponds to 0 VDC, normal working corresponds to 24 VDC.
Fault status is not affected by the Enable input signal.
Fault output signal can be used as digital output by software selection.

16.9 Position transducer input signal

A position transducer must be always directly connected to the axis card. Select the correct axis card execution depending on the desired transducer interface: digital SSI or Encoder (D execution), potentiometer or a generic transducer with analog interface (A execution).
Position digital input signal is factory preset to binary SSI, it can be reconfigured via software selecting between binary/gray SSI and Encoder.
Position analog input signal is factory preset according to selected valve code, defaults are ±10 VDC for standard and 4 ÷ 20 mA for /C option.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.
Refer to position transducer characteristics to select the transducer type according to specific application requirements (see 17.1).

16.10 Remote pressure/force transducer input signals - only for **SF**, **SL**

Analog remote pressure transducers or load cell can be directly connected to the axis card.
Analog input signal is factory preset according to selected valve code, defaults are ±10 VDC for standard and 4 ÷ 20 mA for /C option.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.
Refer to pressure/force transducer characteristics to select the transducer type according to specific application requirements (see 17.2).

17 ACTUATOR'S TRANSDUCER CHARACTERISTICS

17.1 Position transducers

The accuracy of the position control is strongly dependent to the selected position transducer. Four different transducer interfaces are available on the axis cards, depending to the system requirements: potentiometer or analog signal (A execution), SSI or Encoder (D execution).
Transducers with digital interface allow high resolution and accurate measures, that combined with fieldbus communication grants highest performances.
Transducers with analog interface grant simple and cost effective solutions.

17.2 Pressure/force transducers

The accuracy of the force control is strongly dependent to the selected pressure/force transducer, see section 3 .
Alternated force controls require to install pressure transducers or load cell to measure the actual pressure/force values.
Pressure transducers allow easy system integration and cost effective solution for alternated position/force controls (see tech table **GS465** for pressure transducers details).
Load cell transducers allow the user to get high accuracy and precise regulations for alternated position/force control.
The characteristics of the remote pressure/force transducers must be always selected to match the application requirements and to obtain the best performances: transducer nominal range should be at least 115%÷120% of the maximum regulated pressure/force.

17.3 Transducers characteristics & interfaces - following values are just for reference, for details please consult the transducer's datasheet

	Position				Pressure/Force
Execution	A		D		SF, SL
Input type	Potentiometer	Analog	SSI **(3)**	Incremental Encoder	Analog
Power supply **(1)**	±10 V$_{DC}$	+24 V$_{DC}$	+5 V$_{DC}$ / +24 V$_{DC}$	+5 V$_{DC}$ / +24 V$_{DC}$	+24 V$_{DC}$
Axis card interface	±10V	0 ÷ 10V 4 ÷ 20 mA	Serial SSI binary/gray	TTL 5Vpp - 150 KHz	±10 V$_{DC}$ 4 ÷ 20 mA
Max speed	0,5 m/s	1 m/s	2 m/s	2 m/s	-
Max resolution	< 0.4 % FS	< 0.2 % FS	1 µm	1 µm (@ 0.15 m/s)	< 0.4 % FS
Linearity error **(2)**	± 0.1% FS	< ±0.03% FS	< ± 0.01 % FS	< ± 0.001 % FS	< ±0.25% FS
Repeatability **(2)**	± 0.05% FS	< ± 0.005% FS	< ± 0.001 % FS	< ± 0.001 % FS	< ±0.1% FS

(1) Power supply provided by Atos axis card **(2)** Percentage of total stroke **(3)** For Balluff BTL7 with SSI interface only special code SA433 is supported

18 ELECTRONIC CONNECTIONS

18.1 Main connector - 12 pin (A)

PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
1	**V+**	Power supply 24 V$_{DC}$	Input - power supply
2	**V0**	Power supply 0 V$_{DC}$	Gnd - power supply
3	**ENABLE**	Enable (24 V$_{DC}$) or disable (0 V$_{DC}$) the axis card, referred to VL0	Input - on/off signal
4	**P_INPUT+**	Position reference input signal: ±10 V$_{DC}$ / ±20 mA maximum range	Input - analog signal **Software selectable**
5	**INPUT-**	Negative reference input signal for P_INPUT+ and F_INPUT+	Gnd - analog signal
6	**P_MONITOR**	Position monitor output signal: ±10 V$_{DC}$ / ±20 mA maximum range, referred to VL0	Output - analog signal **Software selectable**
7	**F_INPUT+**	Force reference input signal (SF, SL controls): ±10 V$_{DC}$ / ±20 mA maximum range	Input - analog signal **Software selectable**
8	**F_MONITOR**	Force (SF, SL controls) or valve spool position (SN control) monitor output signal: ±10 V$_{DC}$ / ±20mA maximum range, referred to VL0	Output - analog signal **Software selectable**
9	**VL+**	Power supply 24 V$_{DC}$ for axis card logic and communication	Input - power supply
10	**VL0** (1)	Power supply 0 V$_{DC}$ for axis card logic and communication	Gnd - power supply
11	**FAULT**	Fault (0 V$_{DC}$) or normal working (24 V$_{DC}$), referred to VL0	Output - on/off signal
PE	**EARTH**	Internally connected to axis card housing	

(1) Do not disconnect VL0 before VL+ when the axis card is connected to PC USB port

18.2 Communication connectors (B) - (C)

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

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

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

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

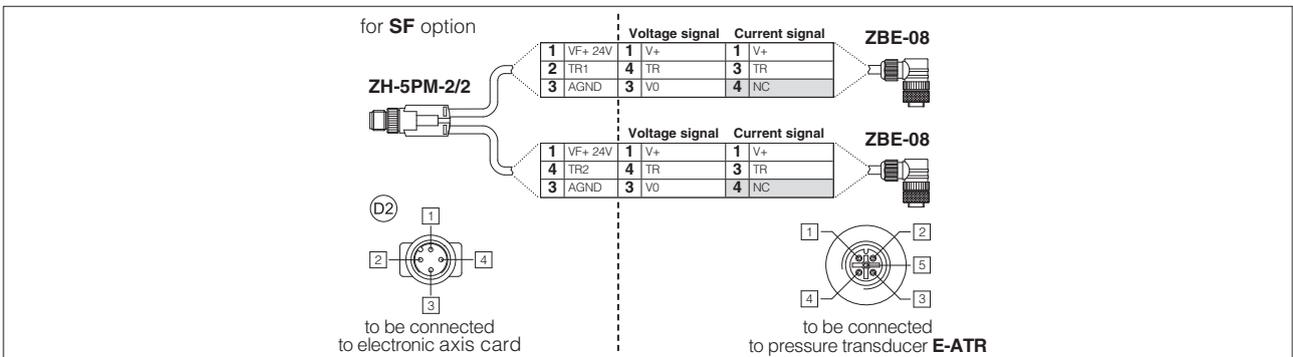**(1)** Shield connection on connector's housing is recommended   **(2)** Pin 2 can be fed with external +5V supply of CAN interface

18.3 Remote pressure/force transducer connector - M12 - 5 pin - only for SF, SL   (D)

PIN	SIGNAL	TECHNICAL SPECIFICATION	NOTES	(D1) SL - Single transducer (1)		(D2) SF - Double transducers (1)	
				Voltage	Current	Voltage	Current
1	VF +24V	Power supply +24VDC	Output - power supply	Connect	Connect	Connect	Connect
2	TR1	1st signal transducer: ±10 VDC / ±20 mA maximum range	Input - analog signal **Software selectable**	Connect	Connect	Connect	Connect
3	AGND	Common gnd for transducer power and signals	Common gnd	Connect	/	Connect	/
4	TR2	2nd signal transducer: ±10 VDC / ±20 mA maximum range	Input - analog signal **Software selectable**	/	/	Connect	Connect
5	NC	Not connect		/	/	/	/

(1) Single/double transducer configuration is software selectable

Remote pressure transducers connection - example
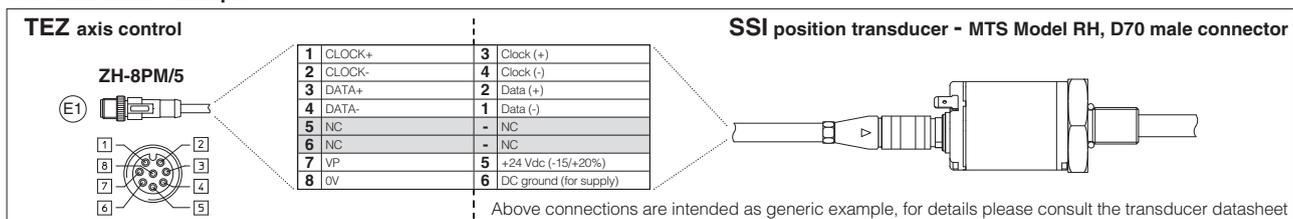

Note: pin layout always referred to axis card view

18.4 D execution - Digital position transducers connector - M12 - 8 pin   (E1)

	SSI - default transducer (1)			Encoder (1)		
PIN	SIGNAL	TECHNICAL SPECIFICATION	NOTES	SIGNAL	TECHNICAL SPECIFICATION	NOTES
1	CLOCK+	Serial syncronous clock (+)	Input - digital signal	R	Input channel R	Input - digital signal
2	CLOCK-	Serial syncronous clock (-)		/R	Input channel /R	
3	DATA+	Serial position data (+)		A	Input channel A	
4	DATA-	Serial position data (-)		/A	Input channel /A	
5	NC	Not connect	Do not connect	B	Input channel B	
6	NC			/B	Input channel /B	
7	VP	Power supply: +24VDC, +5VDC or OFF (default OFF)	Output - power supply **Software selectable**	VP	Power supply: +24VDC, +5VDC or OFF (default OFF)	Output - power supply **Software selectable**
8	0 V	Common gnd for transducer power and signals	Common gnd	0 V	Common gnd for transducer power and signals	Common gnd

(1) Digital position transducer type is software selectable: Encoder or SSI, see 16.9

SSI connection - example

Note: pin layout referred to axis card view

Encoder connection - example
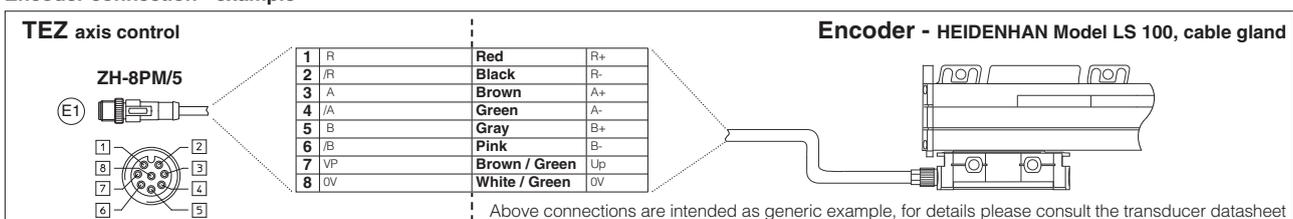
Note: pin layout referred to axis card view

18.5 A execution - Analog position transducers connector - M12 - 5 pin   (E2)

PIN	SIGNAL	TECHNICAL SPECIFICATION	NOTES	Potentiometer	Analog
1	VP +24V	Power supply: +24VDC or OFF (default OFF)	Output - power supply **Software selectable**	/	Connect
2	VP +10V	Power supply reference +10VDC (always present)	Output - power supply	Connect	/
3	AGND	Common gnd for transducer power and signals	Common gnd	Connect	Connect
4	TR	Signal transducer	Input - analog signal	Connect	Connect
5	VP -10V	Power supply reference -10VDC (always present)	Output - power supply	Connect	/

Note: analog input range is software selectable, see 16.9

18.6 TEZ connections layout

MAIN CONNECTORS

ZM-12P - 12 pin - metallic **(1)**
~ 93 / PG13.5 / Ø 28 / A2

A

male - 12 pin **(2)**

ZH-12P - 12 pin - plastic
~ 100 / PG16 / Ø 29 / A4

PLASTIC PROTECTION CAPS - supplied with the valves

Pressure/Force transducers cap
Ø14 / 13.5 / D1 D2

USB cap
Ø14 / 13.5 / B

Tightening torque: 0,6 Nm

Position transducers cap
Ø14 / 13.5 / E1 E2

DO NOT REMOVE

FIELDBUS CONNECTORS

ZM-5PF
C1 / Ø 20 / ~ 58

CANopen
C1
female **(2)**

CANopen
C2
male **(2)**

ZM-5PM
C2 / Ø 20 / ~ 62

ZM-5PF/BP
C1 / Ø 20 / ~ 58

PROFIBUS DP
C1
female **(2)**

PROFIBUS DP
C2
male **(2)**

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

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

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

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

ZM-5PM/BP
C2 / Ø 20 / ~ 62

ZM-4PM/E
C1 / Ø 20 / ~ 58

ZM-4PM/E
C2 / Ø 20 / ~ 58

TRANSDUCERS AND USB CONNECTORS

ZH-5PM/1.5 or **ZH-5PM/5**
SINGLE FORCE
TRANSDUCER CABLE - **SL**
cable lenght 1,5m or 5m
D1 / Ø 15 / ~ 50

Pressure/Force transducers
D1 D2
male **(2)**

ZH-5PM-2/2
DOUBLE PRESSURE
TRANSDUCERS CABLE - **SF**
cable lenght 2m
D2 / Ø 15 / 20 / ~ 50

USB
B
male **(2)**

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

ZH-8PM/5
DIGITAL POSITION
TRANSDUCER CABLE - **D**
cable lenght 5m
E1 / Ø 15 / ~ 50

Digital position transducer (SSI or Encoder)
E1
male **(2)**

ZH-5PM/1.5 or **ZH-5PM/5**
ANALOG POSITION
TRANSDUCERS CABLE - **A**
cable lenght 1,5m or 5m
E2 / Ø 15 / ~ 50

Analog position transducer
E2
male **(2)**

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

18.7 Diagnostic LEDs (L)

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

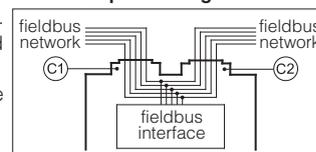| FIELDBUS / LEDS	NP Not Present	BC CANopen	BP PROFIBUS DP	EH EtherCAT	EW POWERLINK	EI EtherNet/IP	EP PROFINET	L1 L2 L3
L1	VALVE STATUS			LINK/ACT				
L2	NETWORK STATUS			NETWORK STATUS				
L3	SOLENOID STATUS			LINK/ACT				

19 IN / OUT FIELDBUS COMMUNICATION CONNECTORS

Two fieldbus communication connectors are always available for digital axis card executions BC, BP, EH, EW, EI, EP. This features allows considerable technical advantages in terms of installation simplicity, wirings reduction and also avoid the usage expensive T-connectors.
For BC and BP executions the fieldbus connectors have an internal pass-through connection and can be used like end point of the fieldbus network, using an external terminator (see tech table **GS500**).
For EH, EW, EI and EP execution the external terminators are not required: each connector is internally terminated.

BC and BP pass-through connection

20 CONNECTORS CHARACTERISTICS - to be ordered separately

20.1   Main connectors

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

20.2 Fieldbus communication connectors

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

(1) E-TRM-** terminators can be ordered separately, see tech table **GS500**   **(2)** Internally terminated

20.3 Pressure/Force transducer connectors - only for **SF, SL**

CONNECTOR TYPE	SL - Single transducer		SF - Double transducers
CODE	(D1) ZH-5PM/1.5	(D1) ZH-5PM/5	(D2) ZH-5PM-2/2
Type	5 pin male straight circular		4 pin male straight circular
Standard	M12 coding A – IEC 61076-2-101		M12 coding A – IEC 61076-2-101
Material	Plastic		Plastic
Cable gland	Connector moulded on cables 1,5 m lenght ｜ 5 m lenght		Connector moulded on cables 2 m lenght
Cable	5 x 0,25 mm²		3 x 0,25 mm² (both cables)
Connection type	molded cable		splitting cable
Protection (EN 60529)	IP 67		IP 67

20.4 Position transducer connectors

CONNECTOR TYPE	DIGITAL POSITION TRANSDUCER D execution - see 18.4	ANALOG POSITION TRANSDUCER A execution - see 18.5	
CODE	(E1) ZH-8PM/5	(E2) ZH-5PM/1.5	(E2) ZH-5PM/5
Type	8 pin male straight circular	5 pin male straight circular	
Standard	M12 coding A – IEC 61076-2-101	M12 coding A – IEC 61076-2-101	
Material	Plastic	Plastic	
Cable gland	Connector moulded on cables 5 m lenght	Connector moulded on cables 1,5 m lenght ｜ 5 m lenght	
Cable	8 x 0,25 mm²	5 x 0,25 mm²	
Connection type	molded cable	molded cable	
Protection (EN 60529)	IP 67	IP 67	

21 | MAIN SOFTWARE PARAMETER SETTINGS

For a detailed descriptions of the available settings, wirings and installation procedures, please refer to the user manuals included in the Z-SW programming software:
Z-MAN-RI-LEZ   - user manual for **TEZ** and **LEZ** with **SN**
Z-MAN-RI-LEZ-S - user manual for **TEZ** and **LEZ** with **SF**, **SL**

21.1 External reference and transducer parameters
Allow to configure the axis card reference and transducer inputs, analog or digital, to match the specific application requirements:
- *Scaling parameters*   define the correspondence of these signals with the specific actuator stroke or force to be controlled
- *Limit parameters*   define maximum/minimum stroke and force to detect possible alarm conditions
- *Homing parameters*   define the startup procedure to initialize incremental transducer (e.g. Encoder)

21.2 PID control dynamics parameters
Allow to optimize and adapt the axis card closed loop to the wide range of hydraulic system characteristics:
- *PID parameters*   each part of the closed loop algorithm (proportional, integral, derivative, feed forward, fine positioning, etc) can be modified to match the application requirements

21.3 Monitoring parameters
Allow to configure the axis card monitoring function of the positioning error (difference between actual reference and feedback) and detects anomalous conditions:
- *Monitoring parameters*   maximum allowed errors can be set for both static and dynamic positioning phases, and dedicated waiting times can be set to delay the activation of the alarm condition and relevant reaction (see 21.4)

21.4 Fault parameters
Allow to configure how the axis card detect and react to alarm conditions:
- *Diagnostics parameters*   define different conditions, threshold and delay time to detect alarm conditions
- *Reaction parameters*   define different actions to be performed in case of alarm presence (stop at actual or preprogrammed position, emergency forward/backward, axis card disabling, etc.)

21.5 Valve characteristics compensation
Allow to modify the valve regulation to match the actuator/system characteristics and to obtain the best overall performances:
- *Valve parameters*   modify the standard valve regulation by means of deadband compensation, curve linearization and differentiated gain for positive and negative regulation

21.6 Motion phases parameters
When the internal reference generation is active a pre-programmed cycle can be generated; start/stop/switch-over commands and reference generation types parameters can be set to design a customized sequence of motion phases adapted to the specific application requirements (see 2.2).

22 | FASTENING BOLTS AND SEALS

|	**DHZO**	**DKZOR**
	Fastening bolts: 4 socket head screws M5x50 class 12.9 Tightening torque = 8 Nm	**Fastening bolts:** 4 socket head screws M6x40 class 12.9 Tightening torque = 15 Nm
	Seals: 4 OR 108; Diameter of ports A, B, P, T: Ø 7,5 mm (max) 1 OR 2025 Diameter of port Y: Ø = 3,2 mm (only for /Y option)	**Seals:** 5 OR 2050; Diameter of ports A, B, P, T: Ø 11,2 mm (max) 1 OR 108 Diameter of port Y: Ø = 5 mm (only for /Y option)

23 **INSTALLATION DIMENSIONS [mm]**

DHZO-TEZ

ISO 4401: 2005
Mounting surface: 4401-03-02-0-05 (see table P005)
(for /Y surface 4401-03-03-0-05 without X port)

Mass [kg]	
DHZO	3,1
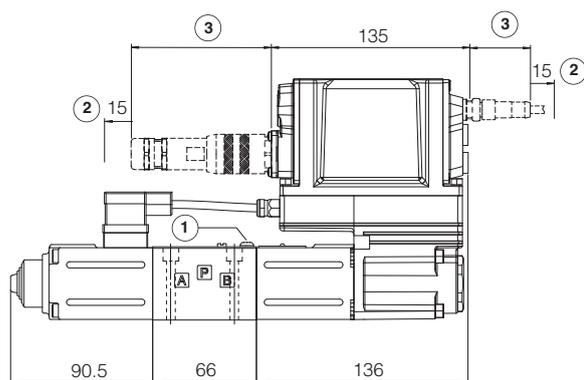
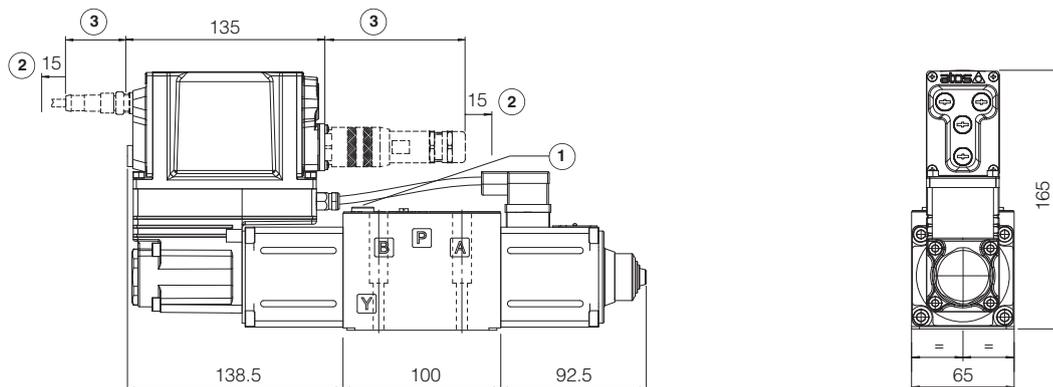135
15
15
155
90.5 · 66 · 136
46

① = Air bleeding 3
② = Space to remove the connectors
③ = The dimensions of all connectors must be considered, see section 18.6

DKZOR-TEZ

ISO 4401: 2005
Mounting surface: 4401-05-04-0-05 (see table P005)
(for /Y surface 4401-05-05-0-05 without X port)

Mass [kg]	
DKZOR	5,0

135
15
15
165
138.5 · 100 · 92.5
65

① = Air bleeding 4 13
② = Space to remove the connectors
③ = The dimensions of all connectors must be considered, see section 18.6

Note: for option /B the proportional solenoid, the LVDT transducer and the on-board digital driver + axis card are at side of port A
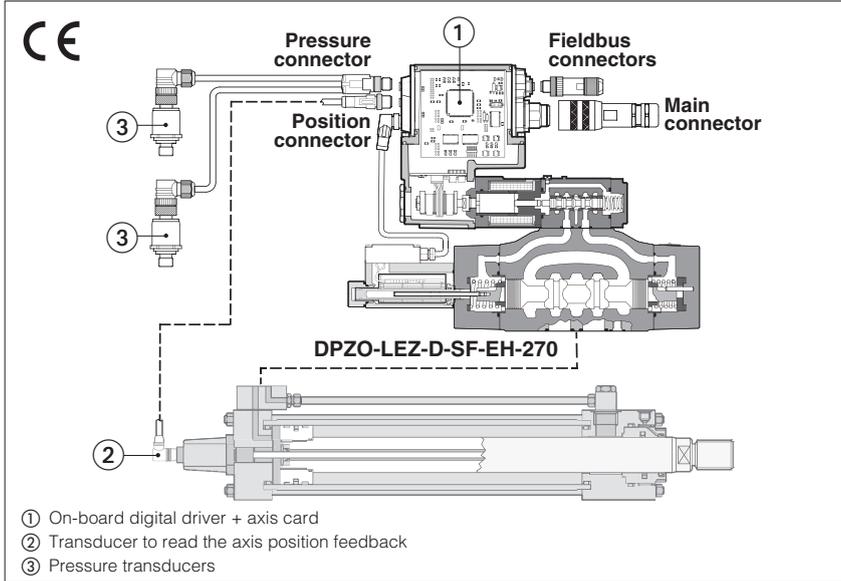
24 **RELATED DOCUMENTATION**

FS001	Basics for digital electrohydraulics	**GS510**	Fieldbus
FS900	Operating and maintenance information for proportional valves	**K800**	Electric and electronic connectors
FY100	Safety proportional valves - option /U	**P005**	Mounting surfaces for electrohydraulic valves
FY200	Safety proportional valves - option /K	**Y010**	Basics for safety components
GS500	Programming tools		

01/20

atos

Table **FS630-0/E**

Digital servoproportionals with on-board axis card
piloted, single solenoid, with two LVDT transducers and zero spool overlap

Pressure connector
Fieldbus connectors
①
Position connector
Main connector

③
③
②

DPZO-LEZ-D-SF-EH-270

① On-board digital driver + axis card
② Transducer to read the axis position feedback
③ Pressure transducers

DPZO-LEZ

Digital servoproportional directional valves, piloted, single solenoid, with on-board digital driver + axis card, two LVDT position transducers and zero spool overlap for position closed loop controls of linear or rotative hydraulic actuator.

The controlled actuator has to be equipped with transducer (analog, potentiometer, SSI or Encoder) to read the axis position feedback.

The valve can be operated via an external reference signal or automatic cycle, see section ②.

Alternated P/Q controls, see ③ :
SF, **SL** = alternated force control added to the basic position one

Safety options TÜV certified, see ⑦ :
U = safe double power supply
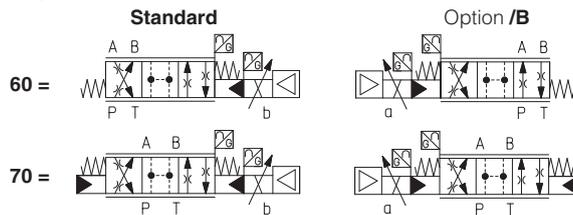**K** = safe on/off signals

Size: **10 ÷ 35** - ISO 4401
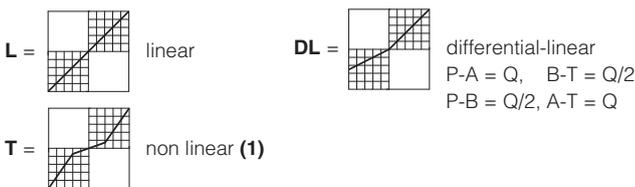Max flow: **180 ÷ 3500 l/min**
Max pressure: **350 bar**

---

1 MODEL CODE

| DPZO | - | LEZ | - | D | - | SN | - | NP | - | 2 | 70 | - | L | 5 | / | * | * | / | * |

Servoproportional directional valves, piloted

LEZ = on-board digital driver + axis card, two LVDT transducers

Position transducer type:
A = Analog (standard, potentiometer)
D = Digital (SSI, Encoder)

Alternated P/Q controls:
SN = none
SF = force control (2 pressure transducers)
SL = force control (1 load cell)

Fieldbus interface, USB port always present:
NP = Not Present
BC = CANopen   **EW** = POWERLINK
BP = PROFIBUS DP   **EI** = EtherNet/IP
EH = EtherCAT   **EP** = PROFINET RT/IRT

Valve size ISO 4401:
1 = 10   **2** = 16   **4** = 25   **4M** = 27   **6** = 32   **8** = 35

Configuration:

	Standard	Option /B
60 =	A B / P T b	A B / P T
70 =	A B / P T b	A B / P T

Spool type, regulating characteristics:

L = linear   **DL** = differential-linear
P-A = Q,   B-T = Q/2
P-B = Q/2, A-T = Q

T = non linear **(1)**

Series number

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

Hydraulic options (2):
B = solenoid with on-board digital driver + axis card and LVDT transducer at side of port B of the main stage (side A of pilot valve)
D = internal drain
E = external pilot pressure
G = pressure reducing valve for piloting

Electronics options (2):
C = current feedback for pressure transducer 4÷20mA (omit for std voltage ±10VDC) - only for **SF, SL**
I = current reference input and monitor 4÷20mA (omit for std voltage ±10VDC)

Safety options TÜV certified **(2)**:
U = safe double power supply
K = safe on/off signals
See section ⑦

SAFETY CERTIFIED

Spool size	**3** (L)	**5** (L,DL)	**5** (L)	**5** (T)
DPZO-1 =	-	100	-	-
DPZO-2 =	160	250	-	190
DPZO-4 =	-	480	-	-
DPZO-4M =	-	550	-	-
DPZO-6 =	-	-	640	-
DPZO-8 =	-	-	1200	-
Nominal flow (l/min) at Δp 10bar P-T				

(1) Not available for configuration 60   **(2)** For possible combined options consult Atos technical office

2 POSITION CONTROL
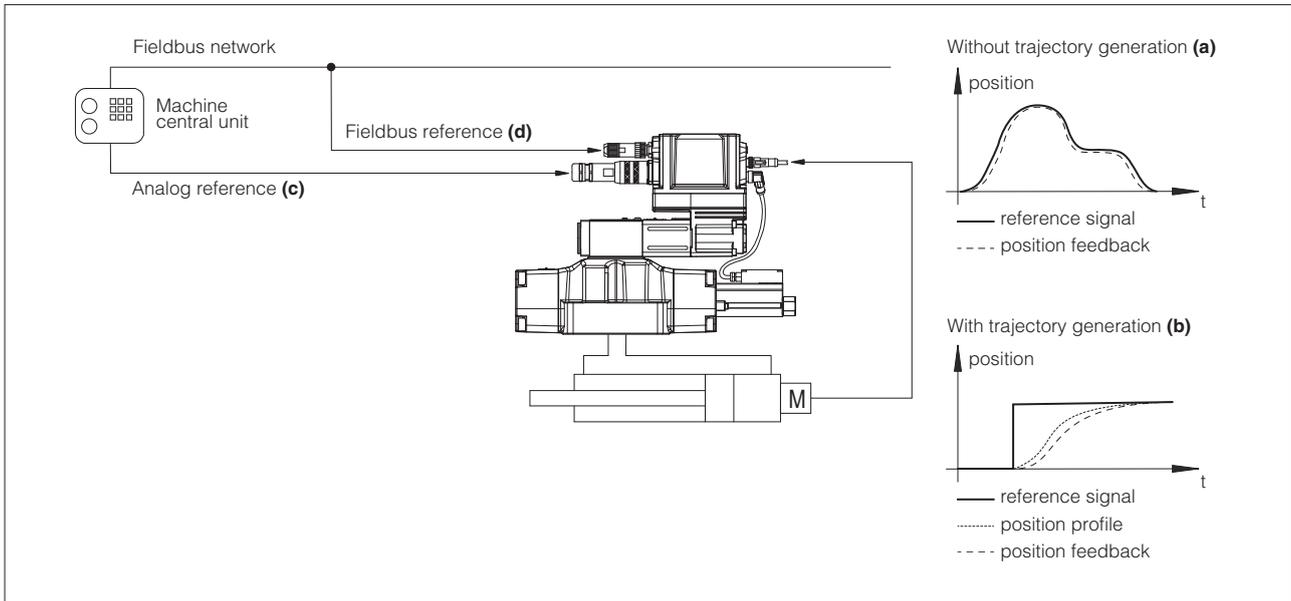
2.1 External reference signal

Axis card controls in closed loop the actuator position according to a reference signal from the machine central unit.

Position profile can be managed in two ways (software selectable):
- Without trajectory generation **(a)**: the axis card receives from the machine central unit the reference signal and follows it at any given instant
- With trajectory generation **(b)**: the axis card receives from the machine central unit just the final target position and internally generates a position profile limiting acceleration, velocity and deceleration

The reference signal can be software selected between Analog reference **(c)** and Fieldbus reference **(d)**.

Refer to the axis card user manual for further details on position control features.

2.2 Automatic cycle

Axis card controls in closed loop the actuator position according to an internally generated automatic cycle: only start, stop and switch-over commands are required from the machine electronic central unit by means On-off commands **(e)** or Fieldbus commands **(f)**.

Atos PC software allows to realize an automatic cycle according to the application requirements. Refer to the axis card user manual for further details on automatic cycle features.
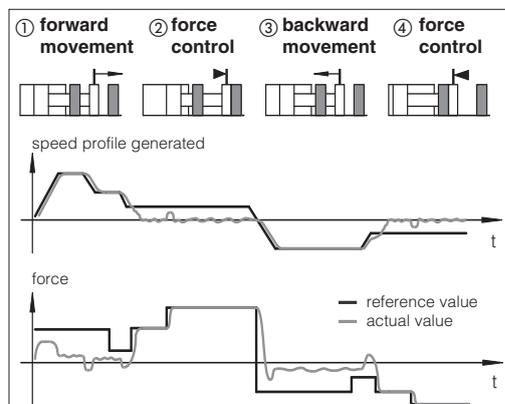
3 | **ALTERNATED POSITION / FORCE CONTROL**

SF and **SL** controls add the alternated force closed loop control to the actuator standard position control. Pressure or force remote transducers have to be installed on the actuator and interfaced to the valve, see below functional schemes.

The position/force controls are operated according to two separate reference signals and a dedicated algorithm automatically selects which control is active time by time.

The dynamics of the switching between the two controls can be regulated thanks to specific software setting, in order to avoid instability and vibrations.

Position control is active (see phase ① and ③ at side) when the actuator force is lower than the relevant reference signal - the valve controls the actuator position by closed-loop regulation.

Force control is active (see phase ② and ④ at side) when the actuator actual force, measured by remote transducers, grows up to the relevant reference signal - the axis card reduces the valve's regulation in order to limit the actuator force; if the force tends to decrease under its reference signal, the position control returns active.

① **forward movement** ② **force control** ③ **backward movement** ④ **force control**

speed profile generated

force

— reference value
— actual value

Alternated control configurations

SF	SL
two remote pressure transducers have to be installed on the actuator's ports; the actuator force is calculated by the pressure feedbacks (Pa - Pb)	one load cell transducer has to be installed between the actuator and the controlled load

T valve spool transducer	**M** actuator position transducer	**P** pressure transducer	**L** load cell

SF – position/force control
Adds force control to standard position control and permits to limit the max force in two directions controlling in closed loop the delta pressure acting on both sides of the hydraulic actuator. Two pressure transducers have to be installed on A and B hydraulic lines.

SL – position/force control
Adds force control to standard position control and permits to limit the max force in one or two directions controlling in closed loop the force performed by the hydraulic actuator. A load cell has to be installed on the hydraulic actuator.

General Notes:
- auxiliary check valves are recommended in case of specific hydraulic configuration requirements in absence of power supply or fault
- Atos technical office is available for additional evaluations related to specific applications

4 GENERAL NOTES

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

5 VALVE SETTINGS AND PROGRAMMING TOOLS

Valve's functional parameters and configurations, can be easily set and optimized using Atos Z-SW programming software connected via USB port to the digital axis card (see table **FS900**). For fieldbus versions, the software permits valve's parameterization through USB port also if the axis card is connected to the central machine unit via fieldbus.
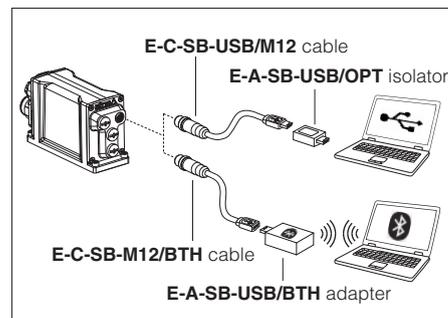
Z-SW-FULL support:
NP (USB)	PS (Serial)	
BC (CANopen)	BP (PROFIBUS DP)	EH (EtherCAT)
EW (POWERLINK)	EI (EtherNet/IP)	EP (PROFINET)

Note: Z-SW programming software supports valves with option SF, SL for alternated control

WARNING: axis card USB port is not isolated! For E-C-SB-USB/M12 cable, the use of isolator adapter is highly recommended for PC protection (see tech table **GS500**)

WARNING: see tech table **GS500** for the list of countries where the Bluetooth adapter has been approved

USB or Bluetooth connection

E-C-SB-USB/M12 cable
E-A-SB-USB/OPT isolator
E-C-SB-M12/BTH cable
E-A-SB-USB/BTH adapter

6 FIELDBUS - see tech. table GS510

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

7 SAFETY OPTIONS

Atos range of proportional directional valves, provides functional safety options **/U** and **/K** , designed to accomplish a safety function, intended to reduce the risk in process control systems.

They are **TÜV certified** in compliance to **IEC 61508 up to SIL 3 and ISO 13849 up to category 4, PL e**

SAFETY CERTIFIED

Safe double power supply, option **/U**: the axis card has separate power supplies for logic and solenoids. The safe condition is reached by cutting the electrical supply to solenoids, while electronics remains active for monitoring functions and fieldbus communication, see tech table **FY100**

Safety function via on/off signals, option **/K**: upon a disable command, the axis card checks the spool position and it provides an on/off acknowledgement signal only when the valve is in safe condition, see tech table **FY200**

8 GENERAL CHARACTERISTICS

Assembly position	Any position
Subplate surface finishing to ISO 4401	Acceptable roughness index: Ra ≤0,8, recommended Ra 0,4 – Flatness ratio 0,01/100
MTTFd valves according to EN ISO 13849	75 years, see technical table P007
Ambient temperature range	**Standard** = -20°C ÷ +60°C **/PE** option = -20°C ÷ +60°C **/BT** option = -40°C ÷ +60°C
Storage temperature range	**Standard** = -20°C ÷ +70°C **/PE** option = -20°C ÷ +70°C **/BT** option = -40°C ÷ +70°C
Surface protection	Zinc coating with black passivation, galvanic treatment (axis card housing)
Corrosion resistance	Salt spray test (EN ISO 9227) > 200 h
Compliance	CE according to EMC directive 2014/30/EU (Immunity: EN 61000-6-2; Emission: EN 61000-6-3) RoHS Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006

9 HYDRAULIC CHARACTERISTICS - based on mineral oil ISO VG 46 at 50 °C

Valve model	DPZO-*-1	DPZO-*-2			DPZO-*-4	DPZO-*-4M	DPZO-*-6	DPZO-*-8
Pressure limits [bar]	ports **P, A, B, X** = 350; **T** = 250 (10 for option /D); **Y** = 10;							
Spool type	**L5, DL5**	**L3**	**L5, DL5**	**T5**	**L5, DL5**		**L5**	
Nominal flow Δp P-T [l/min] **(1)** Δp= 10 bar	100	160	250	190	480	550	640	1200
Δp= 30 bar	160	270	430	330	830	950	1100	2000
Max permissible flow [l/min]	180	400	550	550	1000	1100	1600	3500
Piloting pressure [bar]	min. = 25; max = 350 (option /G advisable for pilot pressure > 200 bar)							
Piloting volume [cm³/min]	1,4	3,7			9	11,3	21,6	39,8
Piloting flow **(2)** [l/min]	3,5	9			18	20	19	24
Leakage **(3)** Pilot [cm³/min]	100 / 300	150 / 450			200 / 600	200 / 600	900 / 2800	900 / 2800
Main stage [l/min]	0,4 / 1,2	0,6 / 2,5			1,0 / 4,0	1,0 / 4,0	3,0 / 9,0	6,0 / 20
Response time **(4)** [ms]	≤ 25	≤ 25			≤ 30	≤ 35	≤ 80	≤ 100
Hysteresis	≤ 0,1 [%of max regulation]							
Repeatability	± 0,1 [%of max regulation]							
Thermal drift	zero point displacement < 1% at ΔT = 40°C							

(1) For different Δp, the max flow is in accordance to the diagrams in section 12.2
(2) With step reference input signal 0 ÷100 %
(3) At p = 100/350 bar
(4) 0-100% step signal, see detailed diagrams in section 12.3

10 **ELECTRICAL CHARACTERISTICS**

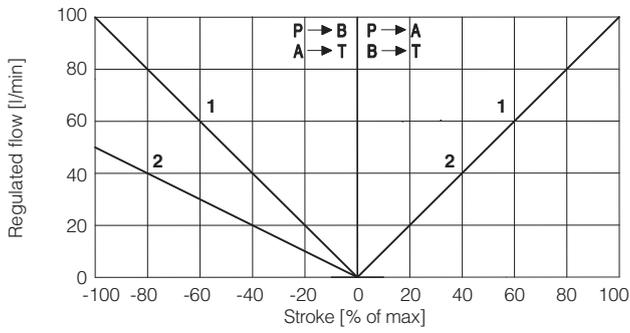|	
Power supplies	Nominal : +24 V$_{DC}$ Rectified and filtered : V$_{RMS}$ = 20 ÷ 32 V$_{MAX}$ (ripple max 10 % V$_{PP}$)
Max power consumption	50 W
Max. solenoid current	2,6 A
Coil resistance R at 20°C	3 ÷ 3,3 Ω
Analog input signals	Voltage: range ±10 V$_{DC}$ (24 V$_{MAX}$ tollerant) Input impedance: Ri > 50 kΩ Current: range ±20 mA Input impedance: Ri = 500 Ω
Monitor outputs	Output range: voltage ±10 V$_{DC}$ @ max 5 mA current ±20 mA @ max 500 Ω load resistance
Enable input	Range: 0 ÷ 5 V$_{DC}$ (OFF state), 9 ÷ 24 V$_{DC}$ (ON state), 5 ÷ 9 V$_{DC}$ (not accepted); Input impedance: Ri > 10 kΩ
Fault output	Output range: 0 ÷ 24 V$_{DC}$ (ON state > [power supply - 2 V] ; OFF state < 1 V) @ max 50 mA; external negative voltage not allowed (e.g. due to inductive loads)
Position transducers power supply	+24 V$_{DC}$ @ max 100 mA and +5 V$_{DC}$ @ max 100 mA are software selectable; ±10 V$_{DC}$ @ max 14 mA minimum load resistance 700 Ω
Pressure/Force transducer power supply (only for SF, SL)	+24V$_{DC}$ @ max 100 mA (E-ATR-8 see tech table **GS465**)
Alarms	Solenoid not connected/short circuit, cable break with current reference signal, over/under temperature, valve spool transducer malfunctions, alarms history storage function
Insulation class	H (180°) Due to the occuring surface temperatures of the solenoid coils, the European standards ISO 13732-1 and EN982 must be taken into account
Protection degree to DIN EN60529	IP66 / IP67 with mating connectors
Duty factor	Continuous rating (ED=100%)
Tropicalization	Tropical coating on electronics PCB
Additional characteristics	Short circuit protection of solenoid's current supply; 3 leds for diagnostic; spool position control, force control (SF, SL) by axis P.I.D. with rapid solenoid switching; protection against reverse polarity of power supply
Electromagnetic compatibility (EMC)	According to Directive 2014/30/UE (Immunity: EN 61000-6-2; Emission: EN 61000-6-3)
Communication interface	USB Atos ASCII coding	CANopen EN50325-4 + DS408	PROFIBUS DP EN50170-2/IEC61158	EtherCAT, POWERLINK, EtherNet/IP, PROFINET IO RT / IRT EC 61158
Communication physical layer	not insulated USB 2.0 + USB OTG	optical insulated CAN ISO11898	optical insulated RS485	Fast Ethernet, insulated 100 Base TX
Recommended wiring cable	LiYCY shielded cables, see section 19

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

11 **SEALS AND HYDRAULIC FLUIDS** - for other fluids not included in below table, consult our technical office
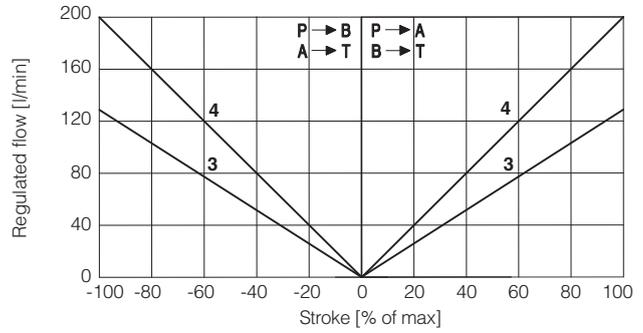
Seals, recommended fluid temperature	NBR seals (standard) = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C
Recommended viscosity	20÷100 mm²/s - max allowed range 15 ÷ 380 mm²/s

Max fluid contamination level	normal operation	ISO4406 class 18/16/13 NAS1638 class 7	see also filter section at www.atos.com or KTF catalog
	longer life	ISO4406 class 16/14/11 NAS1638 class 5	

Hydraulic fluid	Suitable seals type	Classification	Ref. Standard
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	

12 DIAGRAMS (based on mineral oil ISO VG 46 at 50 °C)
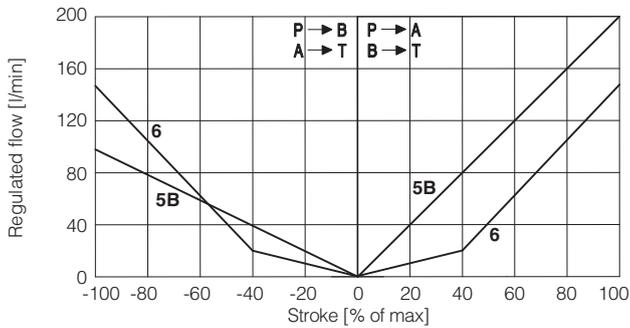
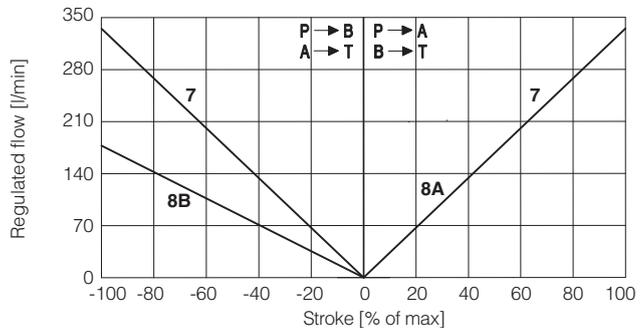**12.1 Regulation diagrams** (values measure at Δp 10 bar P-T)

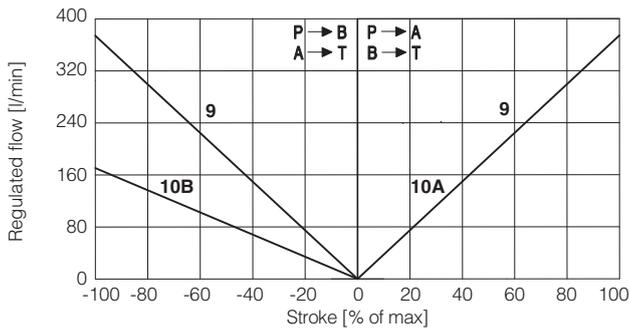**DPZO-1: 1** = L5   **2** = DL5

DPZO-2: 3 = L3   **4** = L5

DPZO-2: 5A = DL5 (P → A, A → T)   **6** = T5
        5B = DL5 (P → B, B → T)

DPZO-4: 7 = L5   **8A** = DL5 (P → A, A → T)
                8B = DL5 (P → B, B → T)

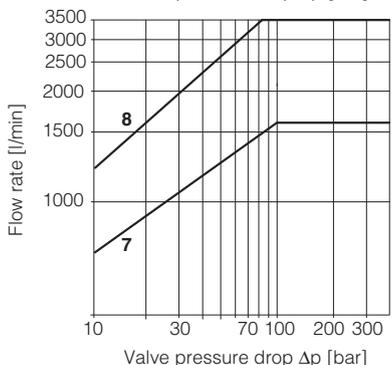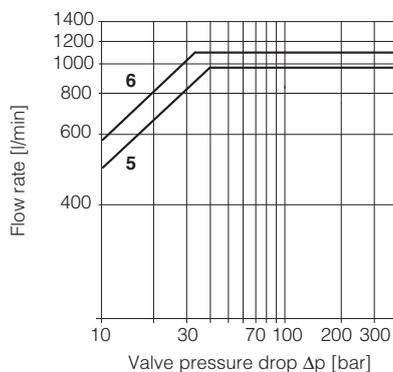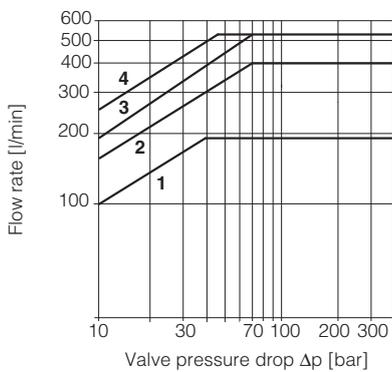**DPZO-4M: 9** = L5   **10A** = DL5 (P → A, A → T)
         10B = DL5 (P → B, B → T)
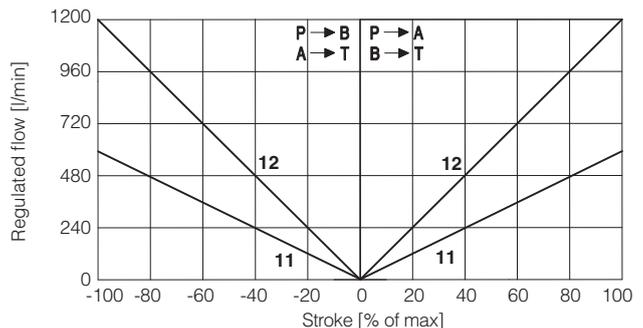
DPZO-6: 11 = L5
DPZO-8: 12 = L5

12.2 Flow /Δp diagram - stated at 100% of spool stroke

DPZO-1:
1 = spools L5, DL5
DPZO-2:
2 = spools L3
3 = spool T5
4 = spools L5, DL5

DPZO-4:
5 = spools L5, DL5
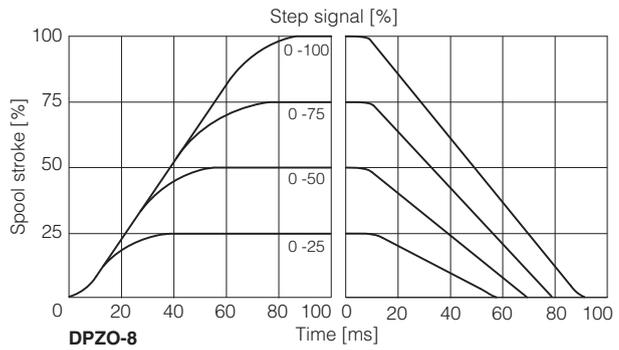**DPZO-4M:**
**6** = spools L5, DL5

DPZO-6:
7 = L5
DPZO-8:
8 = L5

Note: Hydraulic configuration vs. reference signal for configurations
60 and 70 (standard and option /B)

Reference signal $\left.\begin{array}{c} 0 \div +10\ V \\ 12 \div 20\ mA \end{array}\right\}$ P → A / B → T

Reference signal $\left.\begin{array}{c} 0 \div -10\ V \\ 4 \div 12\ mA \end{array}\right\}$ P → B / A → T

12.3 Response time

The response times in below diagrams are measured at different steps of the reference input signal. They have to be considered as average values.
For valves with on-board digital driver + axis card the dynamics performances can be optimized by setting the internal software parameters.

DPZO-1
DPZO-2

DPZO-4
DPZO-4M
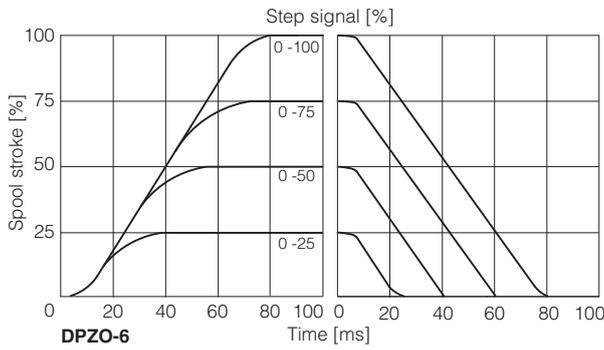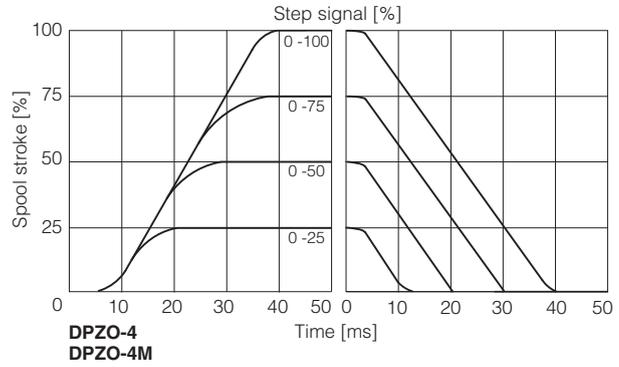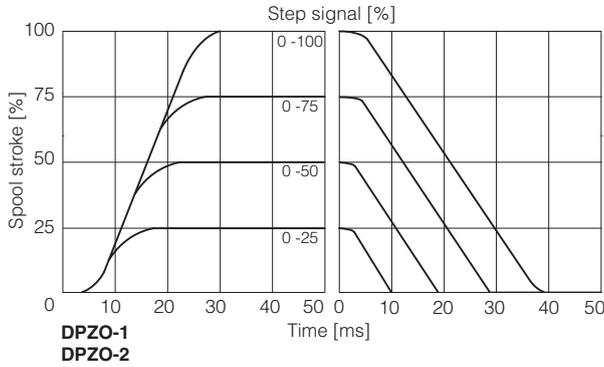
DPZO-6

DPZO-8

12.4 Bode diagrams

Stated at nominal hydraulic conditions.

1 =	DPZO-1 DPZO-2	} ± 5%	**2** =	DPZO-1 DPZO-2 } ± 100%
3 =	DPZO-4 DPZO-4M	} ± 5%	**4** =	DPZO-4 DPZO-4M } ± 100%
5 =	DPZO-6	± 5%	**6** =	DPZO-6 ± 100%
7 =	DPZO-8	± 5%	**8** =	DPZO-8 ± 100%

12.5 Pressure gain
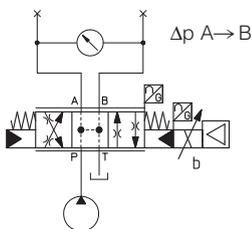
9 = DPZO-1

10 = DPZO-2
DPZO-4
DPZO-4M
DPZO-6
DPZO-8
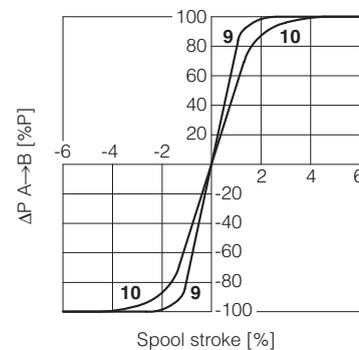
FS630

13 HYDRAULIC OPTIONS

B = Solenoid, on-board digital driver + axis card and LVDT position transducer at side of port B of the main stage (side A of pilot valve). For hydraulic configuration vs reference signal, see 12.1

D = Internal drain (through port T).
Pilot and drain configuration can be modified as shown in the functional scheme here aside. For detailed view of plugs position, see section 22
The valve's standard configuration provides internal pilot and external drain.

E = External pilot (through port X).
Pilot and drain configuration can be modified as shown in the functional scheme here aside. For detailed view of plugs position, see section 22
The valve's standard configuration provides internal pilot and external drain.

G = Pressure reducing valve ③ with fixed setting, installed between pilot valve and main body. Reduced pressure setting:

DPZO-2 = **28 bar**

DPZO-1, DPZO-2, DPZO-4(M), DPZO-6 and DPZO-8 = **40 bar**

It is advisable for valves with internal pilot in case of system pressure higher than 200 bar.
Pressure reducing valve ③ is standard for DPZO-1, for other sizes add /G option.

Functional Scheme - example of configuration 70
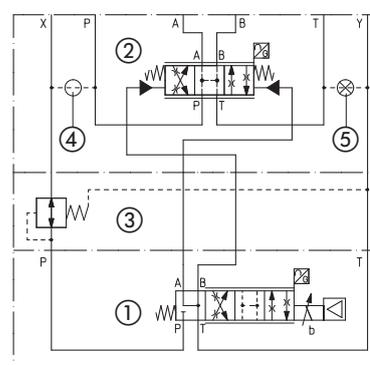
① Pilot valve
② Main stage
③ Pressure reducing valve
④ Plug to be added for external pilot trough port X
⑤ Plug to be removed for internal drain through port T

14 ELECTRONICS OPTIONS

I = This option provides 4 ÷ 20 mA current reference and monitor signals, instead of the standard ±10 VDC.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ±20 mA.
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.

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

15 POWER SUPPLY AND SIGNALS SPECIFICATIONS

Generic electrical output signals of the valve (e.g. fault or monitor signals) must not be directly used to activate safety functions, like to switch-ON/OFF the machine's safety components, as prescribed by the European standards (Safety requirements of fluid technology systems and components-hydraulics, ISO 4413).

For certified safety options: **/U** see tech. table **FY100** and **/K** see tech. table **FY200**

15.1 Power supply (V+ and V0)

The power supply must be appropriately stabilized or rectified and filtered: apply at least a 10000 µF/40 V capacitance to single phase rectifiers or a 4700 µF/40 V capacitance to three phase rectifiers. In case of separate power supply see 15.2.

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

15.2 Power supply for axis card logic and communication (VL+ and VL0)

The power supply for axis card logic and communication must be appropriately stabilized or rectified and filtered: apply at least a 10000 µF/40 V capacitance to single phase rectifiers or a 4700 µF/40 V capacitance to three phase rectifiers.

The separate power supply for axis card logic on pin 9 and 10, allow to remove solenoid power supply from pin 1 and 2 maintaining active the diagnostics, USB and fieldbus communications.

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

15.3 Position reference input signal (P_INPUT+)

Functionality of P_INPUT+ signal (pin 4), depends on axis card reference mode, see section ☐2 :

external analog reference (see 2.1): input is used as reference for control in closed loop the actuator position.
Reference input signal is factory preset according to selected valve code, defaults are ±10 V$_{DC}$ for standard and 4 ÷ 20 mA for /I option.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 V$_{DC}$ or ± 20 mA.

external fieldbus reference (see 2.1) *or automatic cycle* (see 2.2)*:* analog reference input signal can be used as on-off commands with input range 0 ÷ 24 V$_{DC}$.

15.4 Force reference input signal (F_INPUT+) - only for SF, SL

Functionality of F_INPUT+ signal (pin 7), depends on selected axis card reference mode and alternated control options, see section ☐3 :

SL, SF controls and external analog reference selected : input is used as reference for the axis card force closed loop.
Reference input signal is factory preset according to selected valve code, defaults are ±10 V$_{DC}$ for standard and 4 ÷ 20 mA for /I option.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 V$_{DC}$ or ± 20 mA.

SN control or fieldbus reference selected: analog reference input signal can be used as on-off commands with input range 0 ÷ 24V$_{DC}$.

15.5 Position monitor output signal (P_MONITOR)

The axis card generates an analog output signal proportional to the actual axis position; the monitor output signal can be software set to show other signals available in the axis card (e.g. analog reference, fieldbus reference, position error, valve spool position).
Monitor output signal is factory preset according to selected valve code, defaults are ±10 V$_{DC}$ for standard and 4 ÷ 20 mA for /I option.
Output signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 V$_{DC}$ or ± 20 mA.

15.6 Force monitor output signal (F_MONITOR) - only for SF, SL

The axis card generates an analog output signal according to alternated force control option:
SN control: output signal is proportional to the actual valve spool position
SL, SF controls: output signal is proportional to the actual forcel applied to the cylinder's rod end
Monitor output signals can be software set to show other signals available in the axis card (e.g. analog reference, force reference).
The output range and polarity are software selectable within the maximum range ±10 V$_{DC}$ or ±20 mA.
Monitor output signal is factory preset according to selected valve code, defaults are ±10 V$_{DC}$ for standard and 4 ÷ 20 mA for /I option.
Output signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 V$_{DC}$ or ± 20 mA.

15.7 Enable input signal (ENABLE)

To enable the axis card, a 24V$_{DC}$ voltage has to be applied on pin 3.
When the Enable signal is set to zero the axis card can be software set to perform one of the following actions:
- maintain the actuator actual position in close loop control
- move towards a predefined position in closed loop control and maintains the reached position (hold position)
- move forward or backward in open loop (only the valve's closed loop remain active)

15.8 Fault output signal (FAULT)

Fault output signal indicates fault conditions of the axis card (solenoid short circuits/not connected, reference or transducer signal cable broken, maximum error exceeded, etc.). Fault presence corresponds to 0 V$_{DC}$, normal working corresponds to 24 V$_{DC}$.
Fault status is not affected by the Enable input signal.
Fault output signal can be used as digital output by software selection.

15.9 Position transducer input signal

A position transducer must be always directly connected to the axis card. Select the correct axis card execution depending on the desired transducer interface: digital SSI or Encoder (D execution), potentiometer or a generic transducer with analog interface (A execution).
Position digital input signal is factory preset to binary SSI, it can be reconfigured via software selecting between binary/gray SSI and Encoder.
Position analog input signal is factory preset according to selected valve code, defaults are ±10 V$_{DC}$ for standard and 4 ÷ 20 mA for /C option.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 V$_{DC}$ or ± 20 mA.
Refer to position transducer characteristics to select the transducer type according to specific application requirements (see 16.1).

15.10 Remote pressure/force transducer input signals - only for SF, SL

Analog remote pressure transducers or load cell can be directly connected to the axis card.
Analog input signal is factory preset according to selected valve code, defaults are ±10 V$_{DC}$ for standard and 4 ÷ 20 mA for /C option.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 V$_{DC}$ or ± 20 mA.
Refer to pressure/force transducer characteristics to select the transducer type according to specific application requirements (see 16.2).

16 ACTUATOR'S TRANSDUCER CHARACTERISTICS

16.1 Position transducers

The accuracy of the position control is strongly dependent to the selected position transducer. Four different transducer interfaces are available on the axis cards, depending to the system requirements: potentiometer or analog signal (A execution), SSI or Encoder (D execution).
Transducers with digital interface allow high resolution and accurate measures, that combined with fieldbus communication grants highest performances.
Transducers with analog interface grant simple and cost effective solutions.

16.2 Pressure/force transducers

The accuracy of the pressure/force control is strongly dependent to the selected pressure/force transducer, see section 3 .
Alternated pressure/force controls require to install pressure transducers or load cell to measure the actual pressure/force values.
Pressure transducers allow easy system integration and cost effective solution for alternated position/force controls (see tech table **GS465** for pressure transducers details). Load cell transducers allow the user to get high accuracy and precise regulations for alternated position/force control.
The characteristics of the remote pressure/force transducers must be always selected to match the application requirements and to obtain the best performances: transducer nominal range should be at least 115%÷120% of the maximum regulated pressure/force.

16.3 Transducers characteristics & interfaces - following values are just for reference, for details please consult the transducer's datasheet

	Position				Pressure/Force
Execution	A		D		SF, SL
Input type	Potentiometer	Analog	SSI **(3)**	Incremental Encoder	Analog
Power supply **(1)**	±10 V_{DC}	+24 V_{DC}	+5 V_{DC} / +24 V_{DC}	+5 V_{DC} / +24 V_{DC}	+24 V_{DC}
Axis card interface	±10V	0 ÷ 10V 4 ÷ 20 mA	Serial SSI binary/gray	TTL 5Vpp - 150 KHz	±10 V_{DC} 4 ÷ 20 mA
Max speed	0,5 m/s	1 m/s	2 m/s	2 m/s	-
Max resolution	< 0.4 % FS	< 0.2 % FS	1 µm	1 µm (@ 0.15 m/s)	< 0.4 % FS
Linearity error **(2)**	± 0.1% FS	< ±0.03% FS	< ± 0.01 % FS	< ± 0.001 % FS	< ±0.25% FS
Repeatability **(2)**	± 0.05% FS	< ± 0.005% FS	< ± 0.001 % FS	< ± 0.001 % FS	< ±0.1% FS

(1) Power supply provided by Atos axis card **(2)** Percentage of total stroke **(3)** For Balluff BTL7 with SSI interface only special code SA433 is supported

17 ELECTRONIC CONNECTIONS

17.1 Main connector - 12 pin Ⓐ

PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
1	**V+**	Power supply 24 V_{DC}	Input - power supply
2	**V0**	Power supply 0 V_{DC}	Gnd - power supply
3	**ENABLE**	Enable (24 V_{DC}) or disable (0 V_{DC}) the axis card, referred to VL0	Input - on/off signal
4	**P_INPUT+**	Position reference input signal: ±10 V_{DC} / ±20 mA maximum range	Input - analog signal **Software selectable**
5	**INPUT-**	Negative reference input signal for P_INPUT+ and F_INPUT+	Gnd - analog signal
6	**P_MONITOR**	Position monitor output signal: ±10 V_{DC} / ±20 mA maximum range, referred to VL0	Output - analog signal **Software selectable**
7	**F_INPUT+**	Force reference input signal (SF, SL controls): ±10 V_{DC} / ±20 mA maximum range	Input - analog signal **Software selectable**
8	**F_MONITOR**	Force (SF, SL controls) or valve spool position (SN control) monitor output signal: ±10 V_{DC} / ±20mA maximum range, referred to VL0	Output - analog signal **Software selectable**
9	**VL+**	Power supply 24 V_{DC} for axis card logic and communication	Input - power supply
10	**VL0** (1)	Power supply 0 V_{DC} for axis card logic and communication	Gnd - power supply
11	**FAULT**	Fault (0 V_{DC}) or normal working (24 V_{DC}), referred to VL0	Output - on/off signal
PE	**EARTH**	Internally connected to axis card housing	

(1) Do not disconnect VL0 before VL+ when the axis card is connected to PC USB port

17.2 Communication connectors Ⓑ - Ⓒ

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

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

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

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

(1) Shield connection on connector's housing is recommended
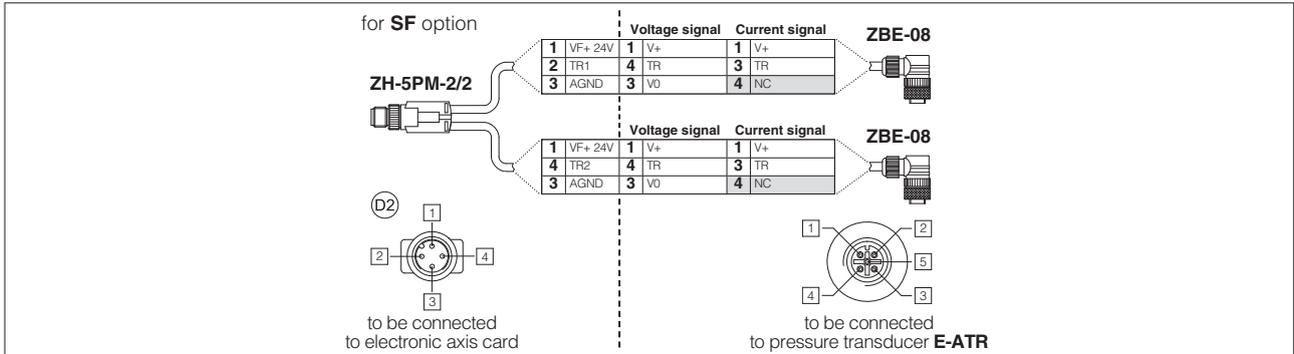
(2) Pin 2 can be fed with external +5V supply of CAN interface

17.3 Remote pressure/force transducer connector - M12 - 5 pin - only for **SF, SL**   (D)

PIN	SIGNAL	TECHNICAL SPECIFICATION	NOTES	(D1) SL - Single transducer (1)		(D2) SF - Double transducers (1)	
				Voltage	Current	Voltage	Current
1	VF +24V	Power supply +24Vdc	Output - power supply	Connect	Connect	Connect	Connect
2	TR1	1st signal transducer: ±10 Vdc / ±20 mA maximum range	Input - analog signal **Software selectable**	Connect	Connect	Connect	Connect
3	AGND	Common gnd for transducer power and signals	Common gnd	Connect	/	Connect	/
4	TR2	2nd signal transducer: ±10 Vdc / ±20 mA maximum range	Input - analog signal **Software selectable**	/	/	Connect	Connect
5	NC	Not connect		/	/	/	/

(1) Single/double transducer configuration is software selectable

Remote pressure transducers connection - example

for **SF** option

ZH-5PM-2/2

			Voltage signal		Current signal		ZBE-08
1	VF+ 24V	1	V+	1	V+		
2	TR1	4	TR	3	TR		
3	AGND	3	V0	4	NC		

			Voltage signal		Current signal		ZBE-08
1	VF+ 24V	1	V+	1	V+		
4	TR2	4	TR	3	TR		
3	AGND	3	V0	4	NC		

(D2)

to be connected to electronic axis card

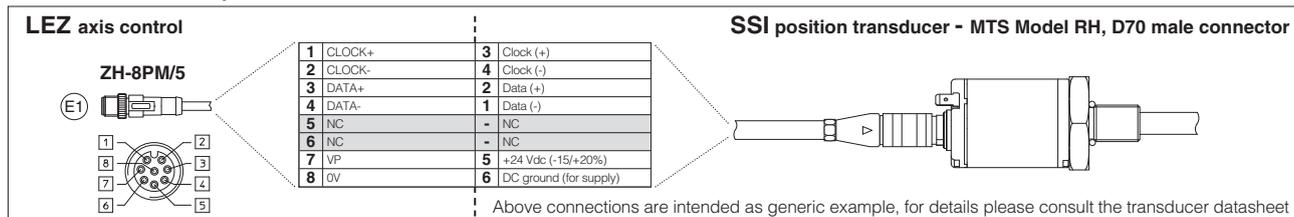to be connected to pressure transducer **E-ATR**

Note: pin layout always referred to axis card view

17.4 D execution - Digital position transducers connector - M12 - 8 pin   (E1)

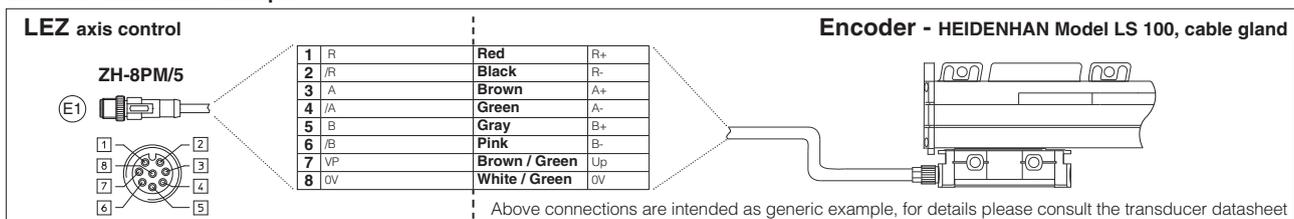|	SSI - default transducer (1)			Encoder (1)		
PIN	SIGNAL	TECHNICAL SPECIFICATION	NOTES	SIGNAL	TECHNICAL SPECIFICATION	NOTES
1	CLOCK+	Serial syncronous clock (+)	Input - digital signal	R	Input channel R	Input - digital signal
2	CLOCK-	Serial syncronous clock (-)		/R	Input channel /R	
3	DATA+	Serial position data (+)		A	Input channel A	
4	DATA-	Serial position data (-)		/A	Input channel /A	
5	NC	Not connect	Do not connect	B	Input channel B	
6	NC			/B	Input channel /B	
7	VP	Power supply: +24Vdc, +5Vdc or OFF (default OFF)	Output - power supply **Software selectable**	VP	Power supply: +24Vdc, +5Vdc or OFF (default OFF)	Output - power supply **Software selectable**
8	0 V	Common gnd for transducer power and signals	Common gnd	0 V	Common gnd for transducer power and signals	Common gnd

(1) Digital position transducer type is software selectable: Encoder or SSI, see 15.9

SSI connection - example

LEZ axis control

ZH-8PM/5

(E1)

SSI position transducer - MTS Model RH, D70 male connector

1	CLOCK+	3	Clock (+)
2	CLOCK-	4	Clock (-)
3	DATA+	2	Data (+)
4	DATA-	1	Data (-)
5	NC	-	NC
6	NC	-	NC
7	VP	5	+24 Vdc (-15/+20%)
8	0V	6	DC ground (for supply)

Above connections are intended as generic example, for details please consult the transducer datasheet

Note: pin layout referred to axis card view

Encoder connection - example

LEZ axis control

ZH-8PM/5

(E1)

Encoder - HEIDENHAN Model LS 100, cable gland

1	R	Red	R+
2	/R	Black	R-
3	A	Brown	A+
4	/A	Green	A-
5	B	Gray	B+
6	/B	Pink	B-
7	VP	Brown / Green	Up
8	0V	White / Green	0V

Above connections are intended as generic example, for details please consult the transducer datasheet
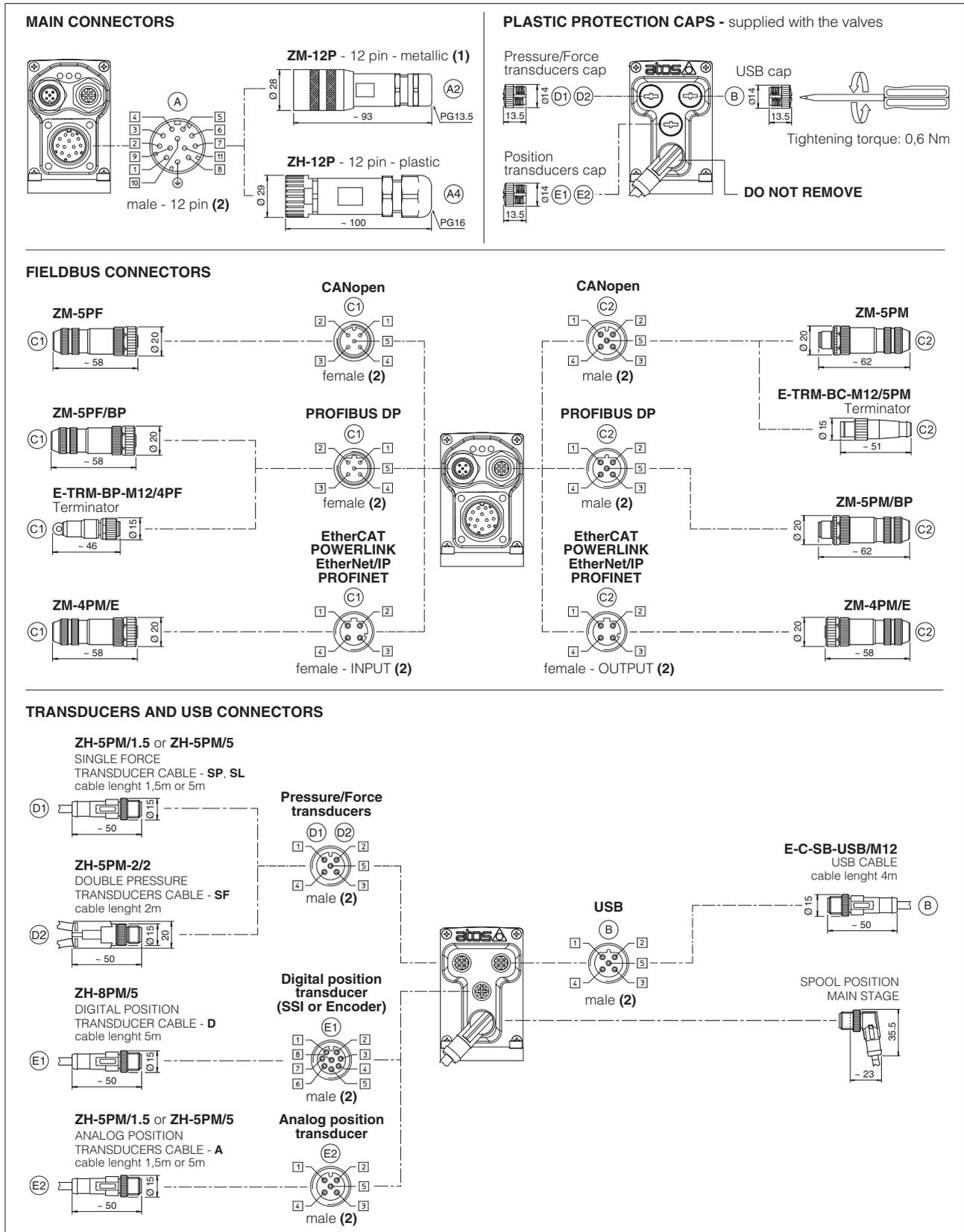
Note: pin layout referred to axis card view

17.5 A execution - Analog position transducers connector - M12 - 5 pin   (E2)

PIN	SIGNAL	TECHNICAL SPECIFICATION	NOTES	Potentiometer	Analog
1	VP +24V	Power supply: +24Vdc or OFF (default OFF)	Output - power supply **Software selectable**	/	Connect
2	VP +10V	Power supply reference +10Vdc (always present)	Output - power supply	Connect	/
3	AGND	Common gnd for transducer power and signals	Common gnd	Connect	Connect
4	TR	Signal transducer	Input - analog signal	Connect	Connect
5	VP -10V	Power supply reference -10Vdc (always present)	Output - power supply	Connect	/

Note: analog input range is software selectable, see 15.9

17.6 LEZ connections layout

MAIN CONNECTORS

ZM-12P - 12 pin - metallic **(1)**
Ø 28
~ 93
PG13.5
A2

ZH-12P - 12 pin - plastic
Ø 29
~ 100
PG16
A4

A
4 5
3 6
2 7
9 11
1 8
10
male - 12 pin **(2)**

PLASTIC PROTECTION CAPS - supplied with the valves

Pressure/Force transducers cap
Ø14 D1 D2
13.5

USB cap
Ø14 B
13.5

Position transducers cap
Ø14 E1 E2
13.5

Tightening torque: 0,6 Nm

DO NOT REMOVE

FIELDBUS CONNECTORS

ZM-5PF
C1 Ø 20 ~ 58

CANopen
C1
2 1
5
3 4
female **(2)**

CANopen
C2
1 2
5
4 3
male **(2)**

ZM-5PM
Ø 20 ~ 62 C2

ZM-5PF/BP
C1 Ø 20 ~ 58

PROFIBUS DP
C1
2 1
5
3 4
female **(2)**

PROFIBUS DP
C2
1 2
5
4 3
male **(2)**

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

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

EtherCAT POWERLINK EtherNet/IP PROFINET
C1
1 2
4 3
female - INPUT **(2)**

EtherCAT POWERLINK EtherNet/IP PROFINET
C2
1 2
4 3
female - OUTPUT **(2)**

ZM-5PM/BP
Ø 20 ~ 62 C2

ZM-4PM/E
C1 Ø 20 ~ 58

ZM-4PM/E
Ø 20 ~ 58 C2

TRANSDUCERS AND USB CONNECTORS

ZH-5PM/1.5 or **ZH-5PM/5**
SINGLE FORCE TRANSDUCER CABLE - **SP**, **SL**
cable lenght 1,5m or 5m
D1 Ø 15 ~ 50

Pressure/Force transducers
D1 D2
1 2
5
4 3
male **(2)**

ZH-5PM-2/2
DOUBLE PRESSURE TRANSDUCERS CABLE - **SF**
cable lenght 2m
D2 Ø 15 / 20 ~ 50

USB
B
1 2
5
4 3
male **(2)**

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

ZH-8PM/5
DIGITAL POSITION TRANSDUCER CABLE - **D**
cable lenght 5m
E1 Ø 15 ~ 50

Digital position transducer (SSI or Encoder)
E1
1 2
8 3
7 4
6 5
male **(2)**

SPOOL POSITION MAIN STAGE
35.5
~ 23

ZH-5PM/1.5 or **ZH-5PM/5**
ANALOG POSITION TRANSDUCERS CABLE - **A**
cable lenght 1,5m or 5m
E2 Ø 15 ~ 50

Analog position transducer
E2
1 2
5
4 3
male **(2)**

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

17.7 Diagnostic LEDs (L)

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

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

L1 L2 L3

18 | IN / OUT FIELDBUS COMMUNICATION CONNECTORS

BC and BP pass-through connection
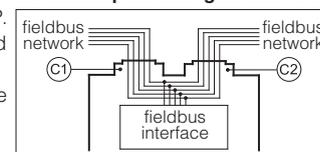
Two fieldbus communication connectors are always available for digital axis card executions BC, BP, EH, EW, EI, EP. This features allows considerable technical advantages in terms of installation simplicity, wirings reduction and also avoid the usage expensive T-connectors.

For BC and BP executions the fieldbus connectors have an internal pass-through connection and can be used like end point of the fieldbus network, using an external terminator (see tech table **GS500**).

For EH, EW, EI and EP execution the external terminators are not required: each connector is internally terminated.

19 | CONNECTORS CHARACTERISTICS - to be ordered separately

19.1   Main connectors

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

19.2 Fieldbus communication connectors

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

(1) E-TRM-** terminators can be ordered separately, see tech table **GS500**   **(2)** Internally terminated

19.3 Pressure/Force transducer connectors - only for **SF, SL**

CONNECTOR TYPE	SL - Single transducer		SF - Double transducers
CODE	(D1) **ZH-5PM/1.5**	(D1) **ZH-5PM/5**	(D2) **ZH-5PM-2/2**
Type	5 pin male straight circular		4 pin male straight circular
Standard	M12 coding A – IEC 61076-2-101		M12 coding A – IEC 61076-2-101
Material	Plastic		Plastic
Cable gland	Connector moulded on cables 1,5 m lenght / 5 m lenght		Connector moulded on cables 2 m lenght
Cable	5 x 0,25 mm²		3 x 0,25 mm² (both cables)
Connection type	molded cable		splitting cable
Protection (EN 60529)	IP 67		IP 67

19.4 Position transducer connectors

CONNECTOR TYPE	DIGITAL POSITION TRANSDUCER D execution - see 17.4	ANALOG POSITION TRANSDUCER A execution - see 17.5	
CODE	(E1) **ZH-8PM/5**	(E2) **ZH-5PM/1.5**	(E2) **ZH-5PM/5**
Type	8 pin male straight circular	5 pin male straight circular	
Standard	M12 coding A – IEC 61076-2-101	M12 coding A – IEC 61076-2-101	
Material	Plastic	Plastic	
Cable gland	Connector moulded on cables 5 m lenght	Connector moulded on cables 1,5 m lenght / 5 m lenght	
Cable	8 x 0,25 mm²	5 x 0,25 mm²	
Connection type	molded cable	molded cable	
Protection (EN 60529)	IP 67	IP 67	

20 MAIN SOFTWARE PARAMETER SETTINGS

For a detailed descriptions of the available settings, wirings and installation procedures, please refer to the user manuals included in the Z-SW programming software:

Z-MAN-RI-LEZ - user manual for **TEZ** and **LEZ** with **SN**
Z-MAN-RI-LEZ-S - user manual for **TEZ** and **LEZ** with **SF**, **SL**

20.1 External reference and transducer parameters

Allow to configure the axis card reference and transducer inputs, analog or digital, to match the specific application requirements:

- *Scaling parameters*   define the correspondence of these signals with the specific actuator stroke or force to be controlled
- *Limit parameters*   define maximum/minimum stroke and force to detect possible alarm conditions
- *Homing parameters*   define the startup procedure to initialize incremental transducer (e.g. Encoder)

20.2 PID control dynamics parameters

Allow to optimize and adapt the axis card closed loop to the wide range of hydraulic system characteristics:

- *PID parameters*   each part of the closed loop algorithm (proportional, integral, derivative, feed forward, fine positioning, etc) can be modified to match the application requirements

20.3 Monitoring parameters

Allow to configure the axis card monitoring function of the positioning error (difference between actual reference and feedback) and detects anomalous conditions:

- *Monitoring parameters*   maximum allowed errors can be set for both static and dynamic positioning phases, and dedicated waiting times can be set to delay the activation of the alarm condition and relevant reaction (see 20.4)

20.4 Fault parameters

Allow to configure how the axis card detect and react to alarm conditions:

- *Diagnostics parameters*   define different conditions, threshold and delay time to detect alarm conditions
- *Reaction parameters*   define different actions to be performed in case of alarm presence (stop at actual or preprogrammed position, emergency forward/backward, axis card disabling, etc.)

20.5 Valve characteristics compensation

Allow to modify the valve regulation to match the actuator/system characteristics and to obtain the best overall performances:

- *Valve parameters*   modify the standard valve regulation by means of deadband compensation, curve linearization and differentiated gain for positive and negative regulation

20.6 Motion phases parameters

When the internal reference generation is active a pre-programmed cycle can be generated; start/stop/switch-over commands and reference generation types parameters can be set to design a customized sequence of motion phases adapted to the specific application requirements (see 2.2).

21 FASTENING BOLTS AND SEALS

| Type	Size	Fastening bolts	Seals
DPZO	**1** = 10	4 socket head screws M6x40 class 12.9 Tightening torque = 15 Nm	5 OR 2050; Diameter of ports A, B, P, T: Ø 11 mm (max) 2 OR 108 Diameter of ports X, Y: Ø = 5 mm (max)
	2 = 16	4 socket head screws M10x50 class 12.9 Tightening torque = 70 Nm 2 socket head screws M6x45 class 12.9 Tightening torque = 15 Nm	4 OR 130; Diameter of ports A, B, P, T: Ø 20 mm (max) 2 OR 2043 Diameter of ports X, Y: Ø = 7 mm (max)
	4 = 25	6 socket head screws M12x60 class 12.9 Tightening torque = 125 Nm	4 OR 4112; Diameter of ports A, B, P, T: Ø 24 mm (max) 2 OR 3056 Diameter of ports X, Y: Ø = 7 mm (max)
	4M = 27	6 socket head screws M12x60 class 12.9 Tightening torque = 125 Nm	4 OR 3137; Diameter of ports A, B, P, T: Ø 32 mm (max) 2 OR 3056 Diameter of ports X, Y: Ø = 7 mm (max)
	6 = 32	6 socket head screws M20x90 class 12.9 Tightening torque = 600 Nm	4 OR 144; Diameter of ports A, B, P, T: Ø 34 mm (max) 2 OR 3056 Diameter of ports X, Y: Ø = 7 mm (max)
	8 = 35	6 socket head screws M20x100 class 12.9 Tightening torque = 600 Nm	4 OR 156; Diameter of ports A, B, P, T: Ø 50 mm (max) 2 OR 3056 Diameter of ports X, Y: Ø = 9 mm (max)

22 PLUGS LOCATION FOR PILOT/DRAIN CHANNELS

Depending on the position of internal plugs, different pilot/drain configurations can be obtained as shown below.
To modify the pilot/drain configuration, proper plugs must only be interchanged. The plugs have to be sealed using loctite 270.
Standard valves configuration provides internal pilot and external drain.
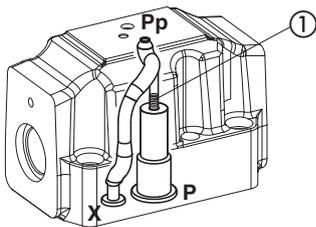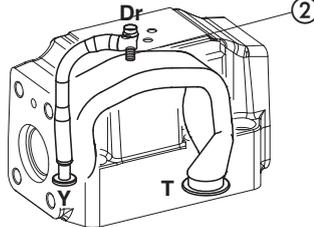
DPZO-1 Pilot channels   Drain channels
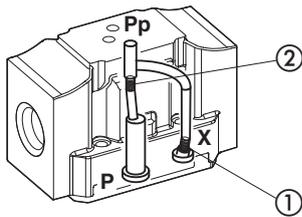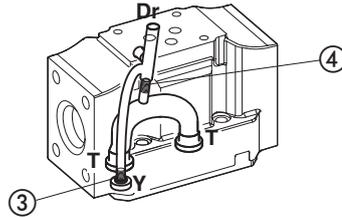
Internal piloting: blinded plug SP-X300F ① in X;
External piloting: blinded plug SP-X300F ② in Pp;
Internal drain: blinded plug SP-X300F ③ in Y;
External drain: blinded plug SP-X300F ④ in Dr.

DPZO-2 Pilot channels   Drain channels

Internal piloting: Without blinded plug SP-X300F ①;
External piloting: Add blinded plug SP-X300F ①;
Internal drain: Without blinded plug SP-X300F ②;
External drain: Add blinded plug SP-X300F ②.

DPZO-4 Pilot channels   Drain channels
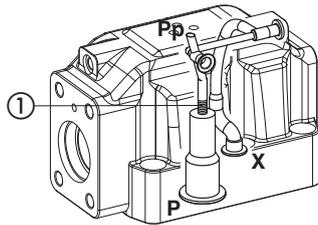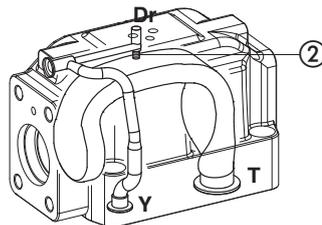
Internal piloting: Without blinded plug SP-X500F ①;
External piloting: Add blinded plug SP-X500F ①;
Internal drain: Without blinded plug SP-X300F ②;
External drain: Add blinded plug SP-X300F ②.
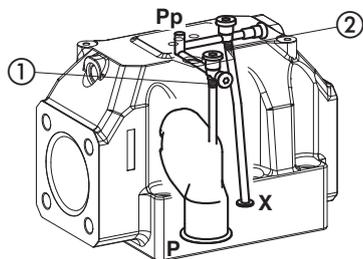
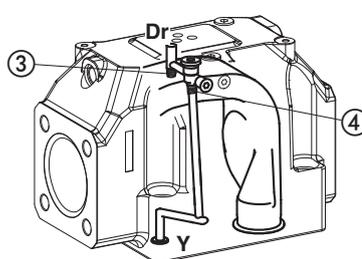**DPZO-6** Pilot channels   Drain channels
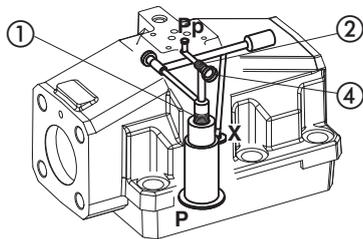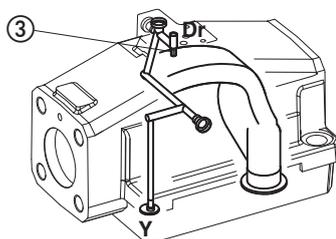
Internal piloting: Without plug ①;
External piloting: Add DIN-908 M16x1,5 in pos ①;
Internal drain: Without blinded plug SP-X300F ③;
External drain: Add blinded plug SP-X300F ③.

DPZO-8 Pilot channels   Drain channels
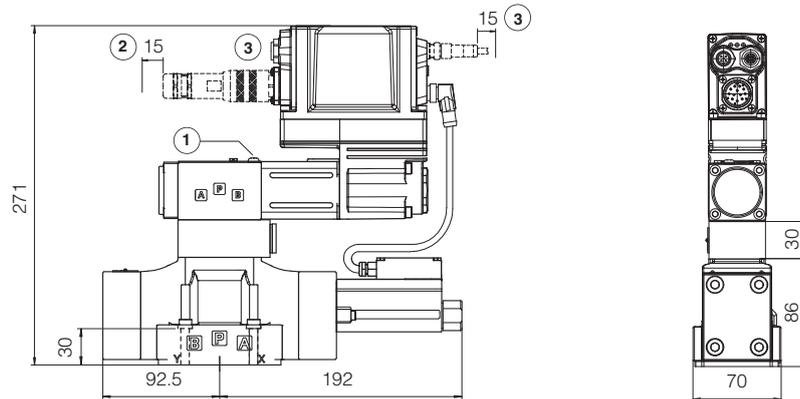

Internal piloting: Without plug ①;
External piloting: Add NPTF 1/8 in pos ①;
                plug NPTF 1/8 in pos ②;
Internal drain: Without plug NPTF 1/8 in pos ③;
                Add plug NPTF 1/8 in pos ④;
External drain: Add plug NPTF 1/8 in pos ③.

23 **INSTALLATION DIMENSIONS [mm]**

DPZO-LEZ-*-1

ISO 4401: 2005
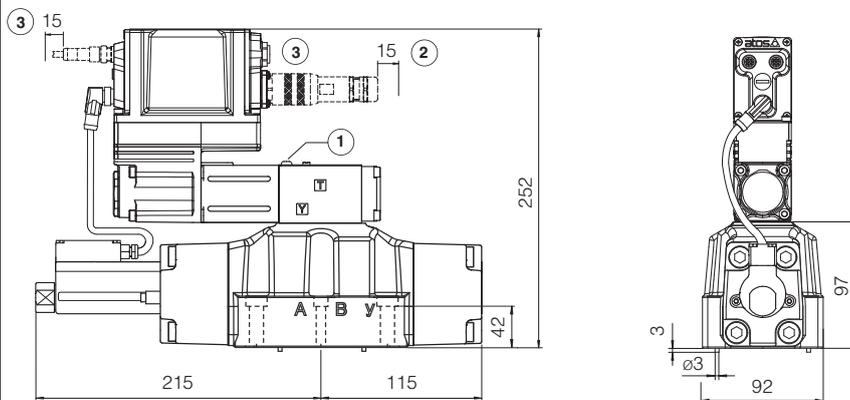**Mounting surface: 4401-05-05-0-05** (see table P005)

Mass [kg]	
DPZO-*-1	9,5

271

30

92.5 192

30

86

70

DPZO-LEZ-*-2

ISO 4401: 2005
Mounting surface: 4401-07-07-0-05 (see table P005)

Mass [kg]	
DPZO-*-2	14

252

42

215 115

3

ø3

92

97

① = Air bleeding 3

② = Space to remove the connectors

③ = The dimensions of all connectors must be considered, see section 18.6

Notes: the overall height is increased by 40 mm for /G option (0,9 kg);
for option /B the proportional solenoid, the LVDT transducer and the on-board digital driver + axis card are at side of port B of the main stage
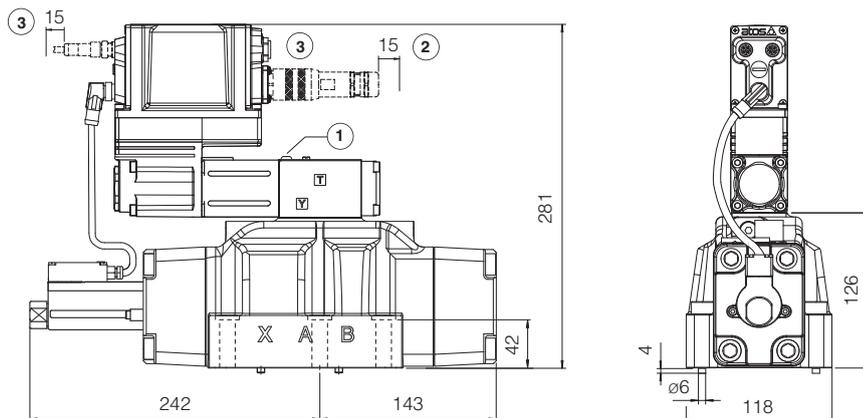
DPZO-LEZ-*-4

ISO 4401: 2005
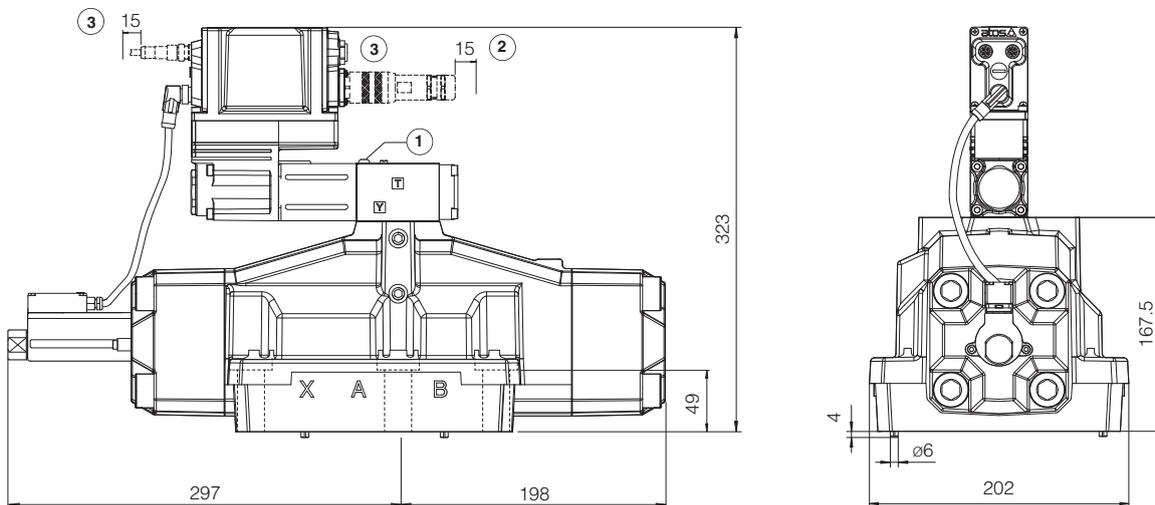Mounting surface: 4401-08-08-0-05 (see table P005)

DPZO-LEZ-*-4M

ISO 4401: 2005
Mounting surface: 4401-08-08-0-05 (see table P005)
ports A, B, P, T Ø 32mm

Mass [kg]	
DPZO-*-4*	19

DPZO-LEZ-*-6

ISO 4401: 2005
Mounting surface: 4401-10-09-0-05 (see table P005)

Mass [kg]	
DPZO-*-6	43

(1) = Air bleeding ⌐ 3

(2) = Space to remove the connectors

(3) = The dimensions of all connectors must be considered, see section 18.6
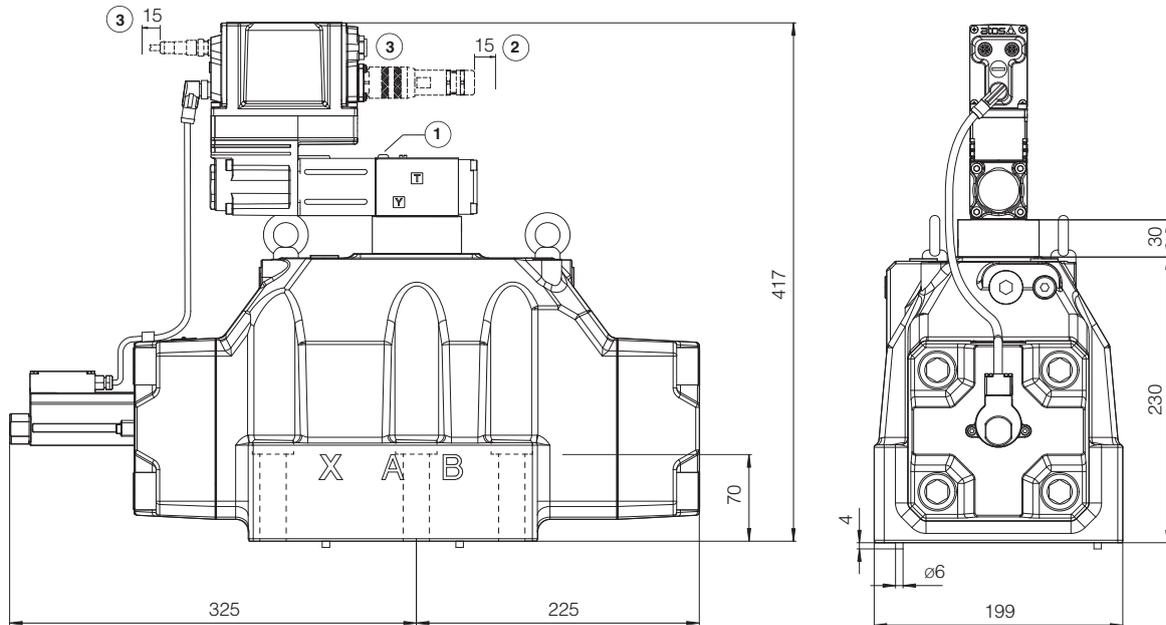
Notes: the overall height is increased by 40 mm for /G option (0,9 kg);
for option /B the proportional solenoid, the LVDT transducer and the on-board digital driver + axis card are at side of port B of the main stage

DPZO-LEZ-*-8

ISO 4401: 2005
Mounting surface: 4401-10-09-0-05 (see table P005)

Mass [kg]	
DPZO-*-8	80

① = Air bleeding ⌐ 3

② = Space to remove the connectors

③ = The dimensions of all connectors must be considered, see section 18.6

Notes: the overall height is increased by 40 mm for /G option (0,9 kg);
for option /B the proportional solenoid, the LVDT transducer and the on-board digital driver + axis card are at side of port B of the main stage

24 RELATED DOCUMENTATION

FS001	Basics for digital electrohydraulics	**GS510**	Fieldbus
FS900	Operating and maintenance information for proportional valves	**K800**	Electric and electronic connectors
FY100	Safety proportional valves - option /U	**P005**	Mounting surfaces for electrohydraulic valves
FY200	Safety proportional valves - option /K	**Y010**	Basics for safety components
GS500	Programming tools		

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