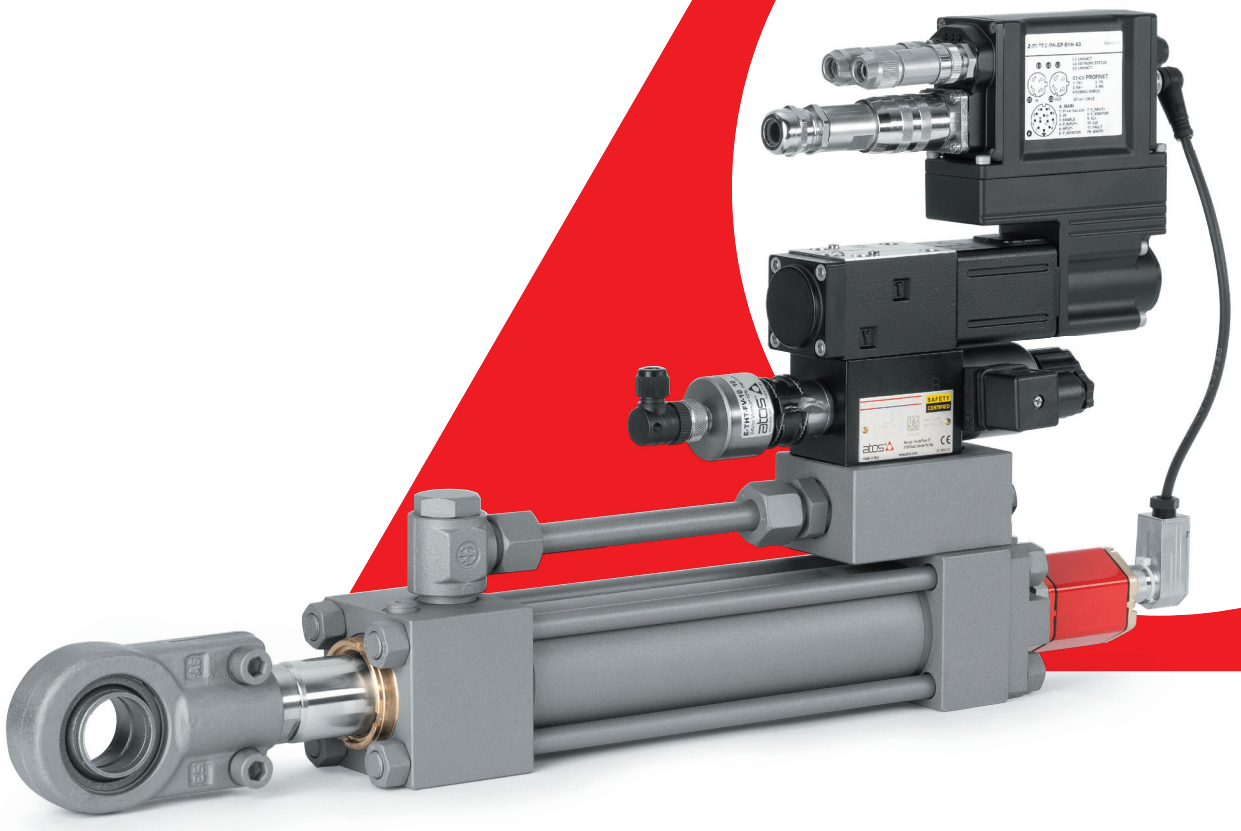
Контроллеры ATOS

Технические характеристики



Алматы (7273)495-231
Ангарск (3955)60-70-56
Архангельск (8182)63-90-72
Астрахань (8512)99-46-04
Барнаул (3852)73-04-60
Белгород (4722)40-23-64
Благовещенск (4162)22-76-07
Брянск (4832)59-03-52
Владивосток (423)249-28-31
Владикавказ (8672)28-90-48
Владимир (4922)49-43-18
Волгоград (844)278-03-48
Вологда (8172)26-41-59
Воронеж (473)204-51-73
Екатеринбург (343)384-55-89
Иваново (4932)77-34-06
Ижевск (3412)26-03-58
Иркутск (395)279-98-46
Казань (843)206-01-48
Калининград (4012)72-03-81
Калуга (4842)92-23-67
Кемерово (3842)65-04-62
Киров (8332)68-02-04
Коломна (4966)23-41-49
Кострома (4942)77-07-48
Краснодар (861)203-40-90
Красноярск (391)204-63-61
Курск (4712)77-13-04
Курган (3522)50-90-47
Липецк (4742)52-20-81
Магнитогорск (3519)55-03-13
Москва (495)268-04-70
Мурманск (8152)59-64-93
Набережные Челны (8552)20-53-41
Нижний Новгород (831)429-08-12
Новокузнецк (3843)20-46-81
Ноябрьск (3496)41-32-12
Новосибирск (383)227-86-73
Омск (3812)21-46-40
Орел (4862)44-53-42
Оренбург (3532)37-68-04
Пенза (8412)22-31-16
Петрозаводск (8142)55-98-37
Псков (8112)59-10-37
Пермь (342)205-81-47
Ростов-на-Дону (863)308-18-15
Рязань (4912)46-61-64
Самара (846)206-03-16
Саранск (8342)22-96-24
Санкт-Петербург (812)309-46-40
Саратов (845)249-38-78
Севастополь (8692)22-31-93
Симферополь (3652)67-13-56
Смоленск (4812)29-41-54
Сочи (862)225-72-31
Ставрополь (8652)20-65-13
Сыктывкар (8212)25-95-17
Тамбов (4752)50-40-97
Сургут (3462)77-98-35
Тверь (4822)63-31-35
Тольятти (8482)63-91-07
Томск (3822)98-41-53
Тула (4872)74-02-29
Тюмень (3452)66-21-18
Ульяновск (8422)24-23-59
Улан-Удэ (3012)59-97-51
Уфа (347)229-48-12
Хабаровск (4212)92-98-04
Чебоксары (8352)28-53-07
Челябинск (351)202-03-61
Череповец (8202)49-02-64
Чита (3022)38-34-83
Якутск (4112)23-90-97
Ярославль (4852)69-52-93

Россия (495)268-04-70
Казахстан (772)734-952-31
Киргизия (996)312-96-26-47

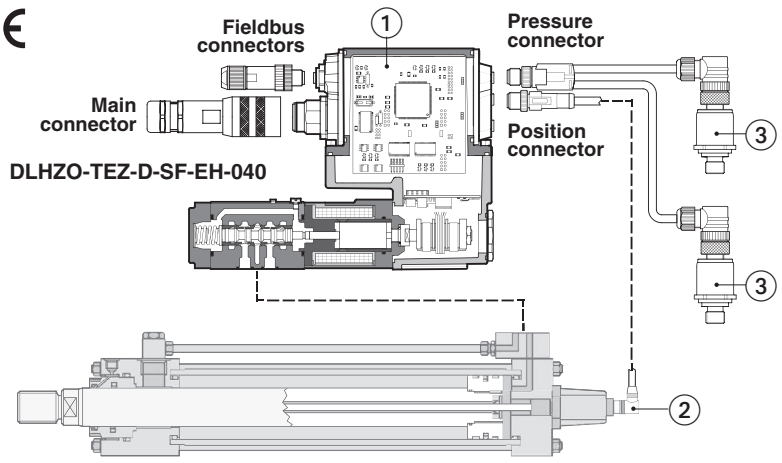
www.atos.nt-rt.ru ‖ aoy@nt-rt.ru

INDEX

AXIS & P/Q CONTROLS

Digital servoproportionals with on-board axis card

direct, single solenoid, sleeve execution, with LVDT transducer and zero spool overlap



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:	**DLKZOR**:
Size: **06** -ISO 4401	Size: **10** -ISO 4401
Max flow: **70 l/min**	Max flow: **160 l/min**
Max pressure: **350 bar**	Max pressure: **315 bar**

[1] MODEL CODE

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

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)

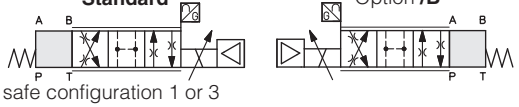
Alternated P/Q controls:
SN = none
SF = force control (2 pressure transducers)
SL = force control (1 load cell)

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

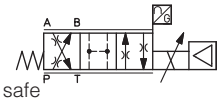
Valve size ISO 4401: **0** = 06 **1** = 10

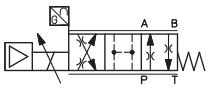
Configuration: **Standard** Option **/B**

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

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 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

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

2 POSITION CONTROL

2.1 External reference signal

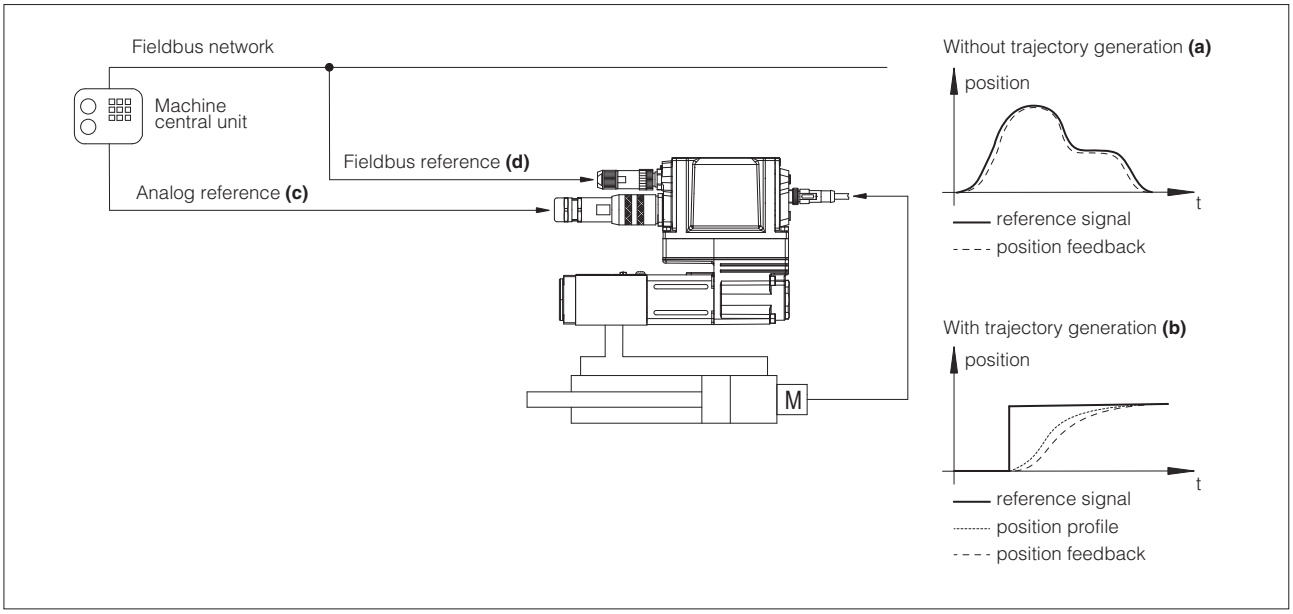
Axis card controls in closed loop the actuator position according to a reference signal from the machine central unit.

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)**.

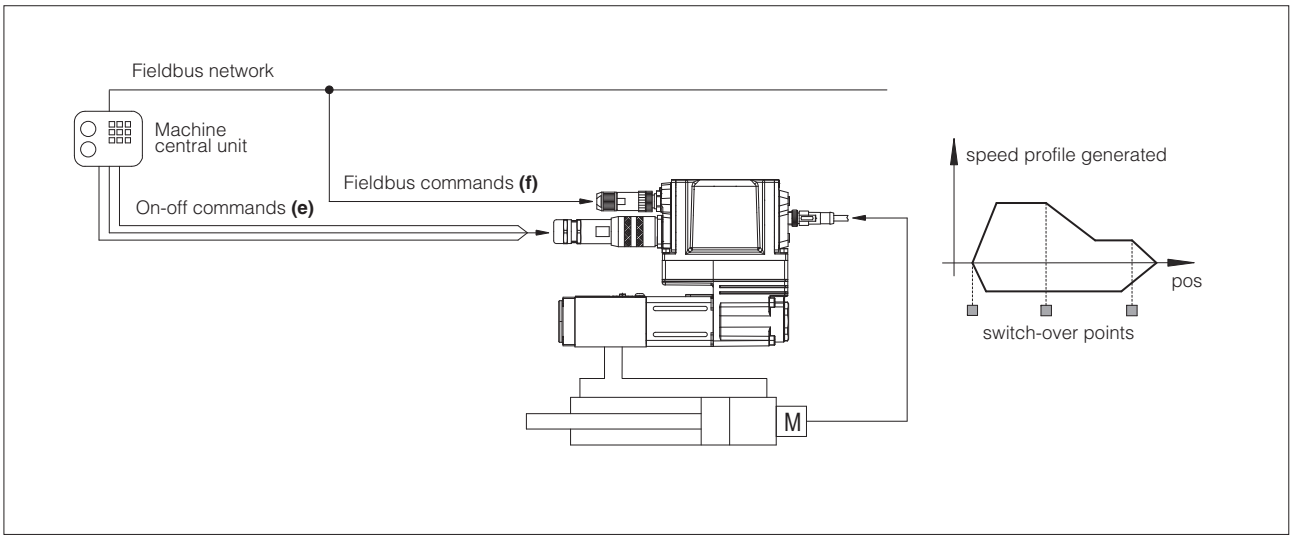
Refer to the axis card user manual for further details on position control features.



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

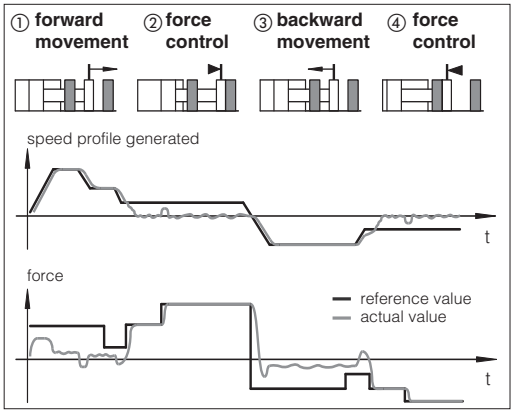
SF and **SL** controls add the alternated force closed loop control to the actuator standard position control. Pressure or force remote transducers have to be installed on the actuator and interfaced to the valve, see below functional schemes.

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.

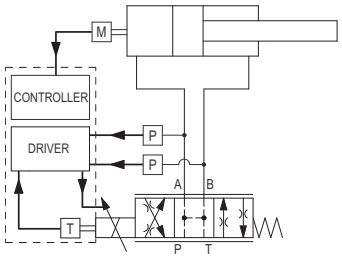
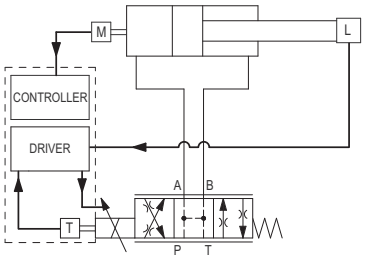
The dynamics of the switching between the two controls can be regulated thanks to specific software setting, in order to avoid instability and vibrations.

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.



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

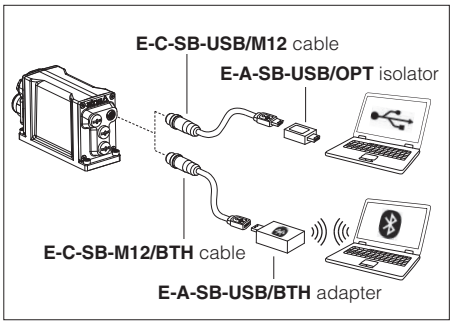
Valve's functional parameters and configurations, can be easily set and optimized using Atos Z-SW programming software connected via USB port to the axis card (see table **FS900**).
For fieldbus versions, the software permits valve's parameterization through USB port also if the axis card is connected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

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**)

USB or Bluetooth connection



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**

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 VDC Rectified and filtered : VRMS = 20 ÷ 32 VMAX (ripple max 10 % VPP)			
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 VDC (24 VMAX tollerant) Input impedance: Ri > 50 kΩ Current: range ±20 mA Input impedance: Ri = 500 Ω			
Monitor outputs	Output range: voltage ±10 VDC @ max 5 mA current ±20 mA @ max 500 Ω load resistance			
Enable input	Range: 0 ÷ 5 VDC (OFF state), 9 ÷ 24 VDC (ON state), 5 ÷ 9 VDC (not accepted); Input impedance: Ri > 10 kΩ			
Fault output	Output range: 0 ÷ 24 VDC (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 VDC @ max 100 mA and +5 VDC @ max 100 mA are software selectable; ±10 VDC @ max 14 mA minimum load resistance 700 Ω			
Pressure/Force transducer power supply (only for SF, SL)	+24VDC @ 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 VDC power supply and when the valve is ready to operate. During this time the current to the valve coils is switched to zero.

11 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 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	

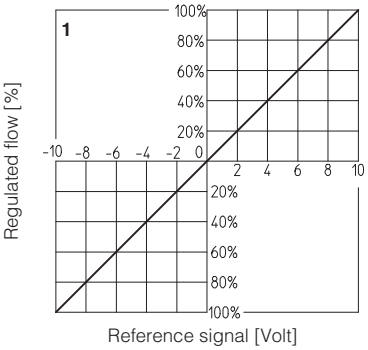
12 DIAGRAMS (based on mineral oil ISO VG 46 at 50 °C)

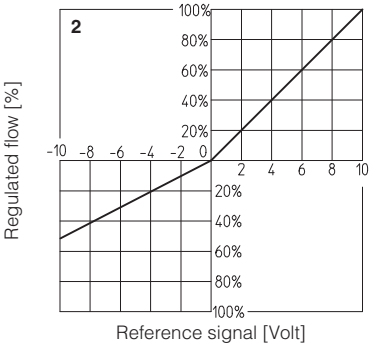
12.1 Regulation diagrams

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

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

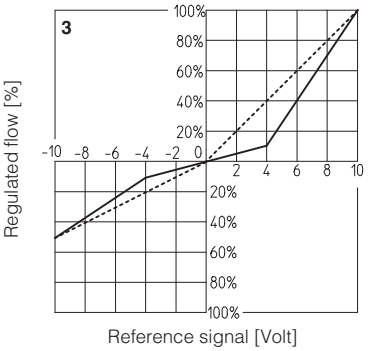
5 = Non linear spool T3 (only for DLHZO) and T7
6 = Progressive spool V

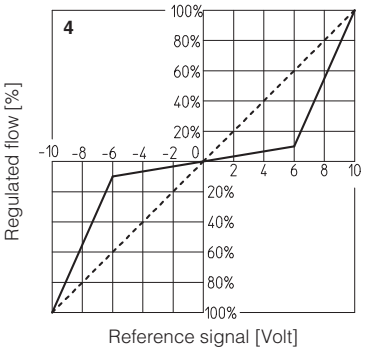




T3, T5 and T7 spool types are specific for fine low flow control in the range from 0 to 60% (T5) and 0 to 40% (T3 and T7) of max spool stroke.
The non linear characteristics of the spool is compensated by the axis card, so the final valve regulation is resulting linear respect the reference signal (dotted line).

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

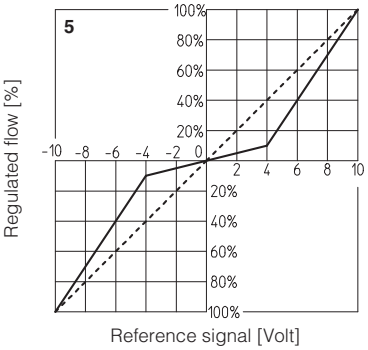


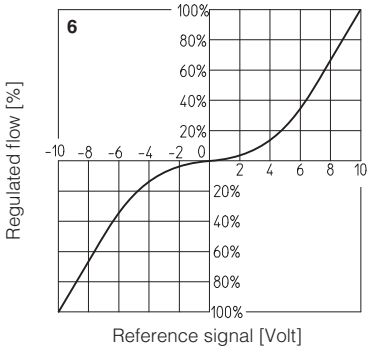


Note:
Hydraulic configuration vs. reference signal:

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

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



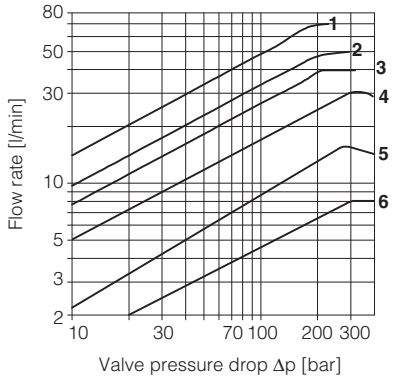


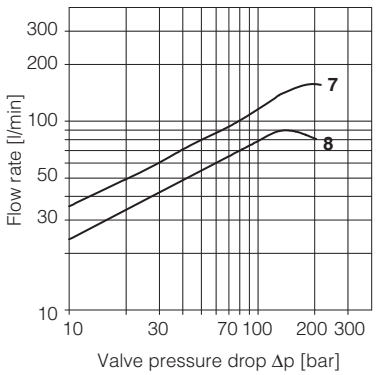
12.2 Flow /Δp diagrams

Stated at 100% of spool stroke

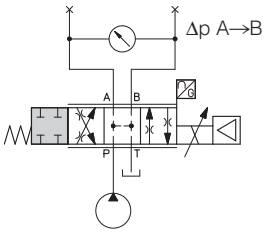
DLHZO:
1 = spool L7, T7, V7, D7, DT7
2 = spool L5, T5
3 = spool V3
4 = spool L3
5 = spool L1, V1
6 = spool L0

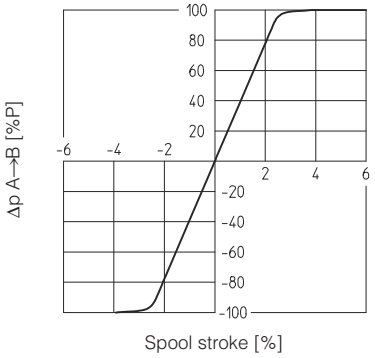
DLKZOR:
7 = spool L7, T7, V7, D7, DT7
8 = spool L3





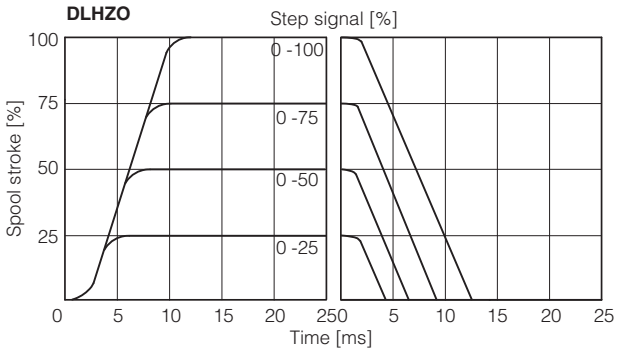
12.3 Pressure gain

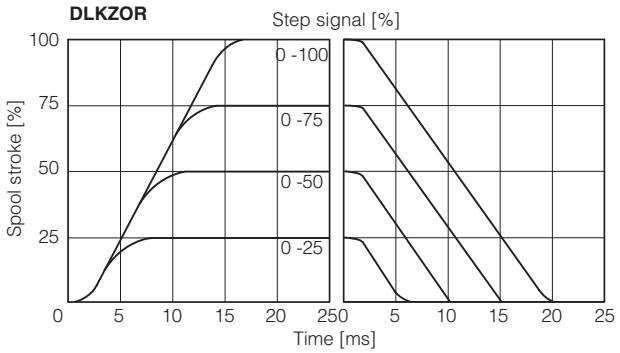




12.4 Response time

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.



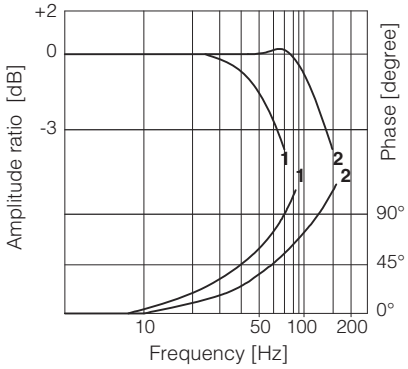


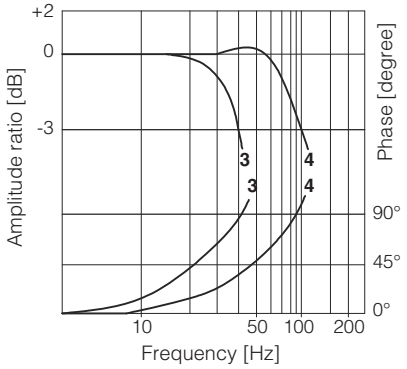
12.5 Bode diagrams

Stated at nominal hydraulic conditions

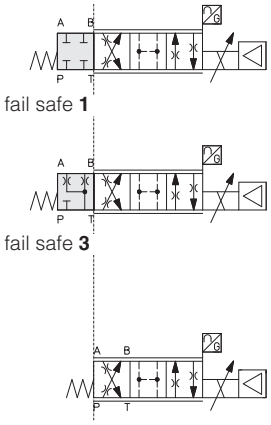
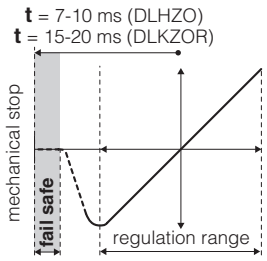
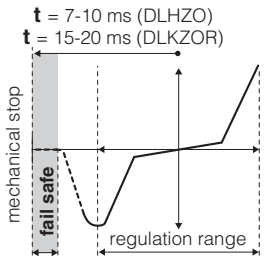
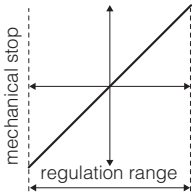
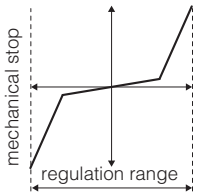
DLHZO:
1 = ± 100% nominal stroke
2 = ± 5% nominal stroke

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





13 FAIL SAFE POSITION

CONFIGURATION	LINEAR	NOT LINEAR
		
	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	
		

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 / DLKZOR	Fail safe 3	-	-	15÷30	10÷20
		-	-	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 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.

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 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 ÷ 24 VDC.

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 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.

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 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.

17.7 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)

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 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.

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 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 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 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 18.2).

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

	Position				**Pressure/Force**
Execution	**A**		**D**		**SF, SL**
Input type	Potentiometer	Analog	SSI **(3)**	Incremental Encoder	Analog
Power supply **(1)**	±10 VDC	+24 VDC	+5 VDC / +24 VDC	+5 VDC / +24 VDC	+24 VDC
Axis card interface	±10V	0 ÷ 10V 4 ÷ 20 mA	Serial SSI binary/gray	TTL 5Vpp - 150 KHz	±10 VDC 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 (A)

PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
1	**V+**	Power supply 24 VDC	Input - power supply
2	**V0**	Power supply 0 VDC	Gnd - power supply
3	**ENABLE**	Enable (24 VDC) or disable (0 VDC) the axis card, referred to VL0	Input - on/off signal
4	**P_INPUT+**	Position reference input signal: ±10 VDC / ±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 VDC / ±20 mA maximum range, referred to VL0	Output - analog signal **Software selectable**
7	**F_INPUT+**	Force reference input signal (SF, SL controls): ±10 VDC / ±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 VDC / ±20mA maximum range, referred to VL0	Output - analog signal **Software selectable**
9	**VL+**	Power supply 24 VDC for axis card logic and communication	Input - power supply
10	**VL0** (1)	Power supply 0 VDC for axis card logic and communication	Gnd - power supply
11	**FAULT**	Fault (0 VDC) or normal working (24 VDC), 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 (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

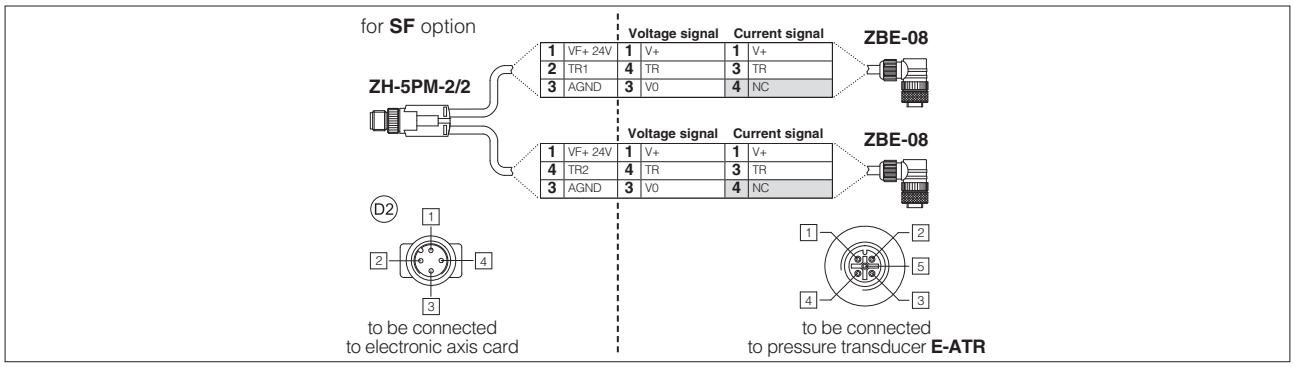
(2) Pin 2 can be fed with external +5V supply of CAN interface

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 +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



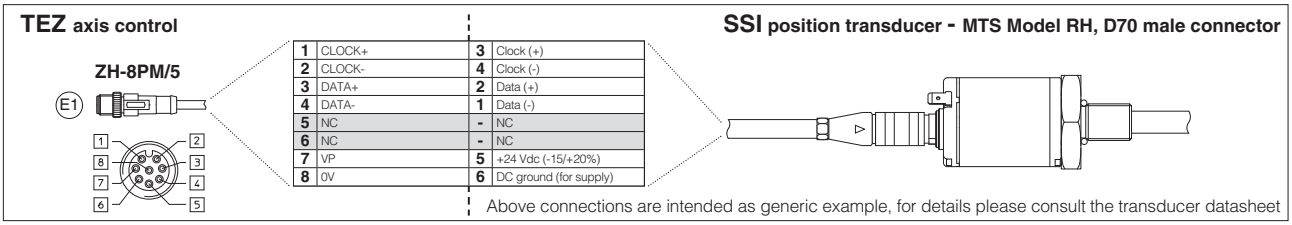
Note: pin layout always referred to axis card view

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: +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

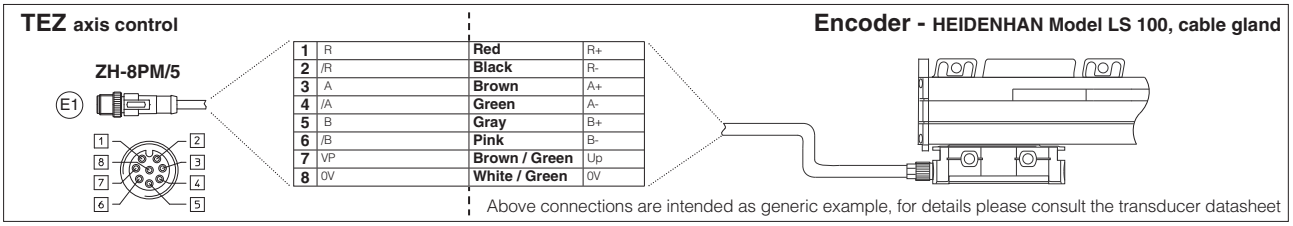
(1) Digital position transducer type is software selectable: Encoder or SSI, see 17.9

SSI connection - example



Note: pin layout referred to axis card view

Encoder connection - example



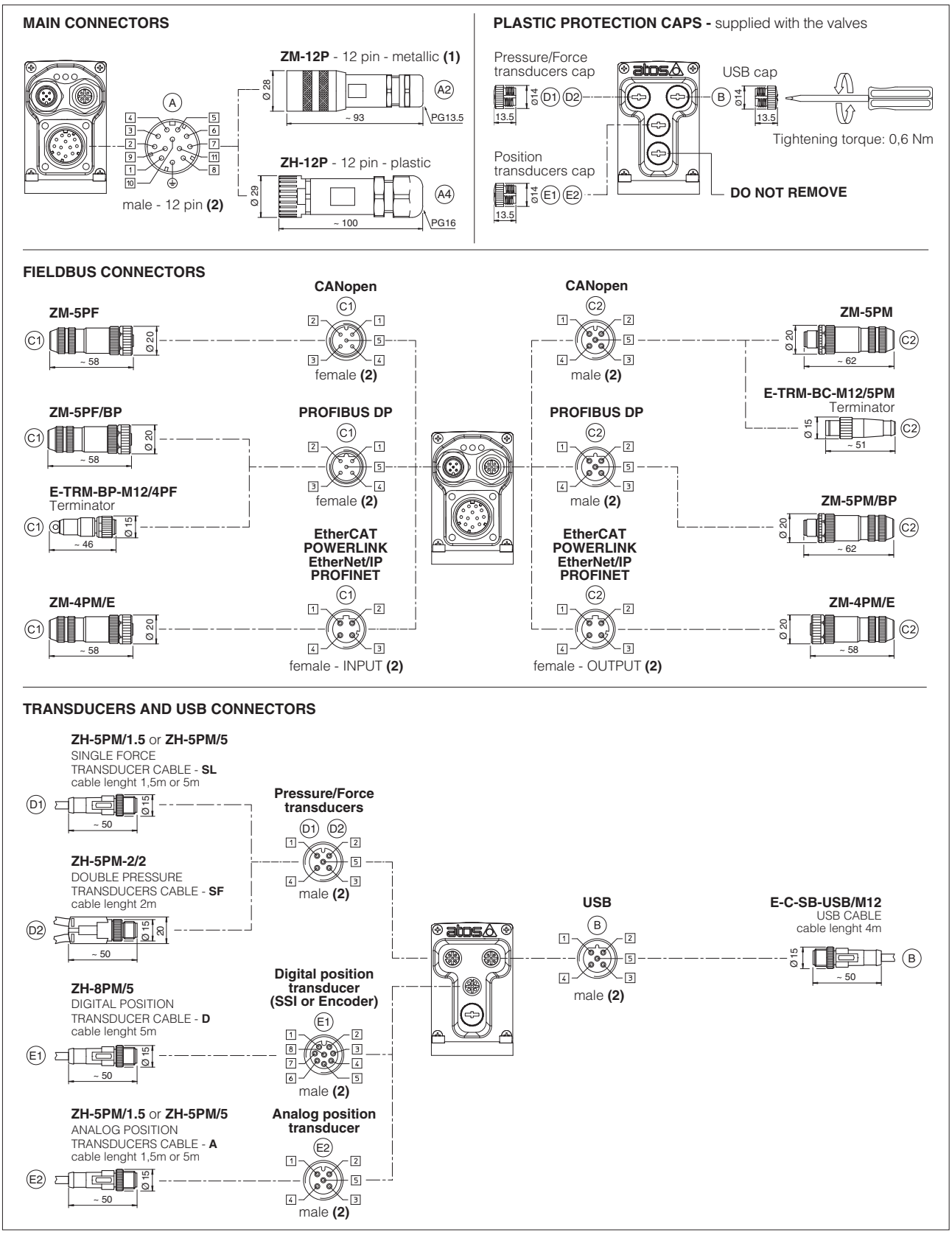
Note: pin layout referred to axis card view

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

PIN	SIGNAL	TECHNICAL SPECIFICATION	NOTES	Potentiometer	Analog
1	**VP +24V**	Power supply: +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 17.9

19.6 TEZ connections layout



(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)

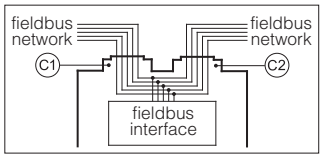
Three leds show axis card operative conditions for immediate basic diagnostics. Please refer to the axis card user manual for detailed information.

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

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

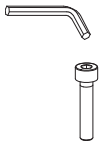
Allow to modify the valve regulation to match the actuator/system characteristics and to obtain the best overall performances:

- *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

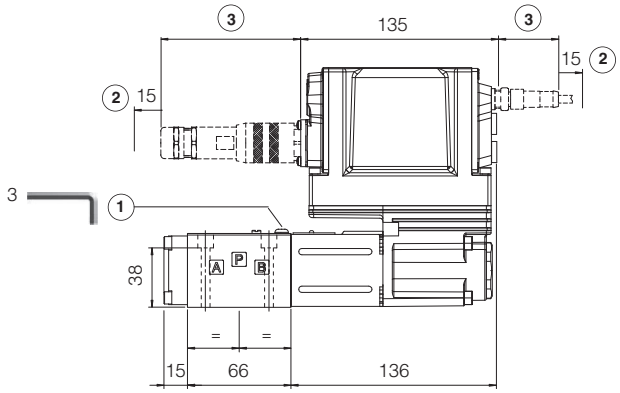
	DLHZO	**DLKZOR**
	**Fastening bolts:** 4 socket head screws M5x50 class 12.9 Tightening torque = 8 Nm	**Fastening bolts:** 4 socket head screws M6x40 class 12.9 Tightening torque = 15 Nm
	**Seals:** 4 OR 108; Diameter of ports A, B, P, T: Ø 7,5 mm (max) 1 OR 2025 Diameter of port Y: Ø = 3,2 mm (only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

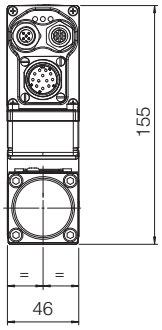
24 INSTALLATION DIMENSIONS [mm]

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

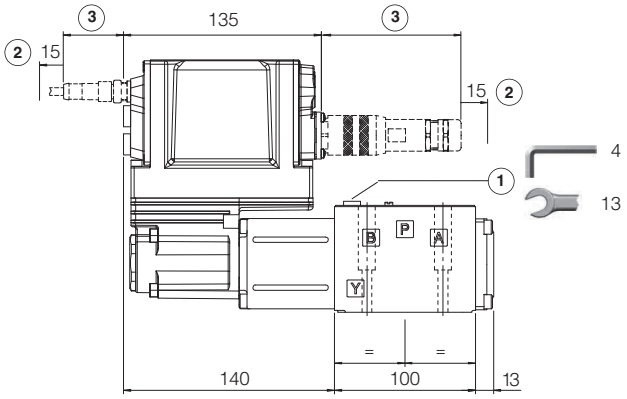


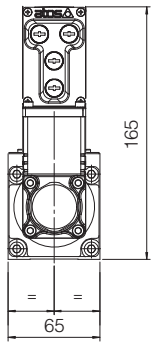


DLKZOR-TEZ

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

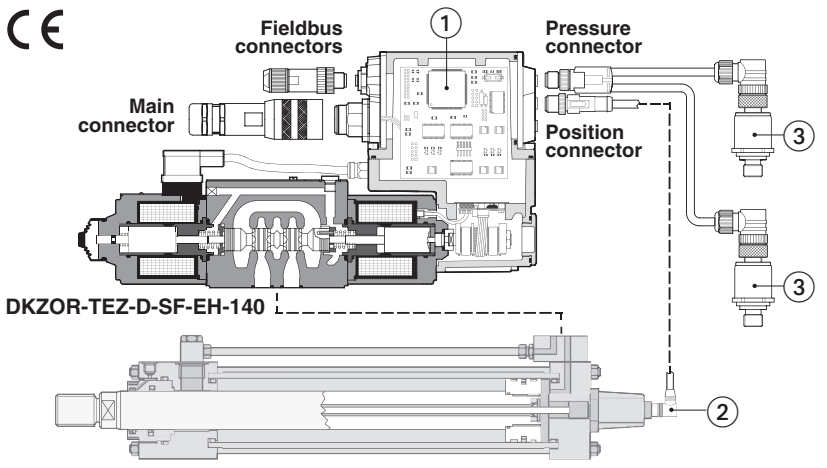
Note: for option /B the proportional solenoid, the LVDT transducer and the on-board digital driver + axis card are at side of port A

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		

Digital servoproportionals with on-board axis card

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



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	/ *	*	/ *

DHZO
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)

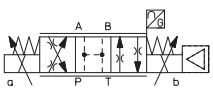
Fieldbus interface, USB port always present:
NP = Not Present
BC = CANopen
BP = PROFIBUS DP
EH = EtherCAT
EW = POWERLINK
EI = EtherNet/IP
EP = PROFINET RT/IRT

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

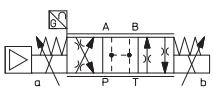
Configuration:

Standard

70 =



Option **/B**



Series number

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

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

(1) For possible combined options, see section [15]

2 POSITION CONTROL

2.1 External reference signal

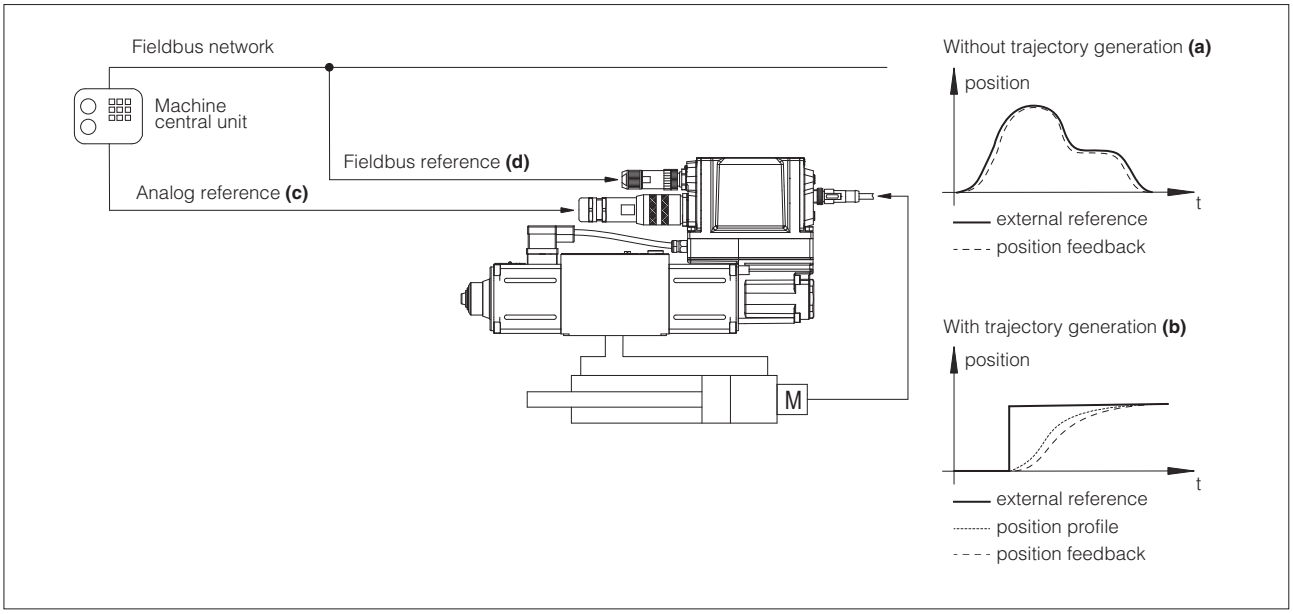
Axis card controls in closed loop the actuator position according to a reference signal from the machine central unit.

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)**.

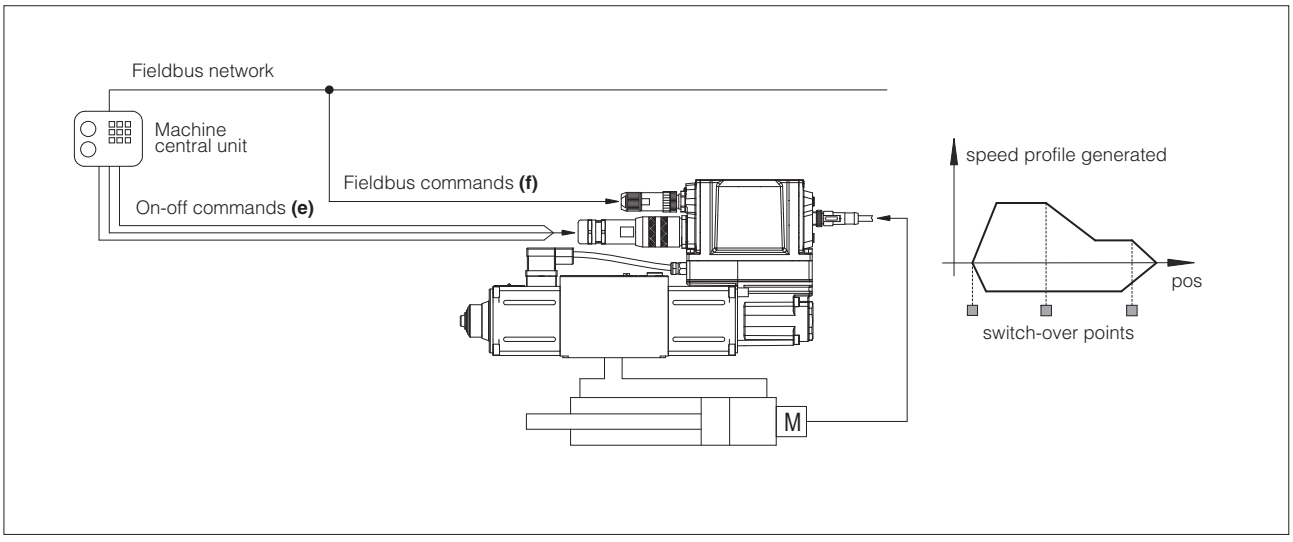
Refer to the axis card user manual for further details on position control features.



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

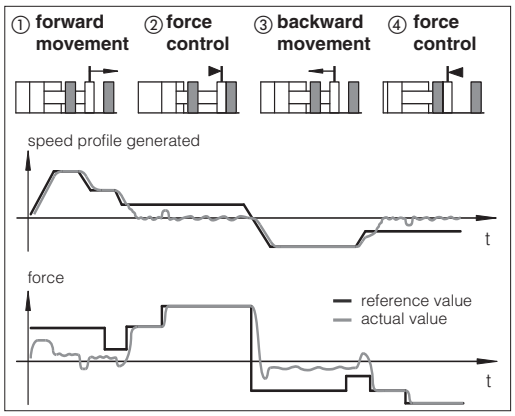
SF and **SL** controls add the alternated force closed loop control to the actuator standard position control. Pressure or force remote transducers have to be installed on the actuator and interfaced to the valve, see below functional schemes.

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.

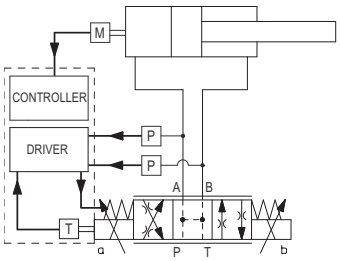
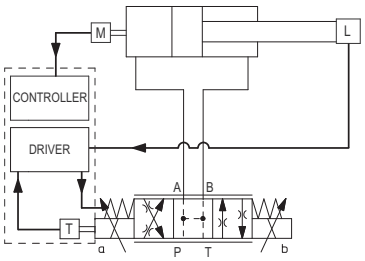
The dynamics of the switching between the two controls can be regulated thanks to specific software setting, in order to avoid instability and vibrations.

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.



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

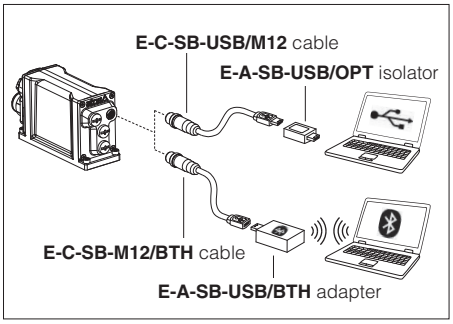
Valve's functional parameters and configurations, can be easily set and optimized using Atos Z-SW programming software connected via USB port to the digital axis card (see table **FS900**).
For fieldbus versions, the software permits valve's parameterization through USB port also if the axis card is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

USB or Bluetooth connection



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**

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]					
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) See detailed diagrams in section 12.3
(3) 0-100% step signal

10 ELECTRICAL CHARACTERISTICS

Power supplies	Nominal : +24 VDC Rectified and filtered : VRMS = 20 ÷ 32 VMAX (ripple max 10 % VPP)			
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 VDC (24 VMAX tollerant) Input impedance: Ri > 50 kΩ Current: range ±20 mA Input impedance: Ri = 500 Ω			
Monitor outputs	Output range: voltage ±10 VDC @ max 5 mA current ±20 mA @ max 500 Ω load resistance			
Enable input	Range: 0 ÷ 5 VDC (OFF state), 9 ÷ 24 VDC (ON state), 5 ÷ 9 VDC (not accepted); Input impedance: Ri > 10 kΩ			
Fault output	Output range: 0 ÷ 24 VDC (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 VDC @ max 100 mA and +5 VDC @ max 100 mA are software selectable; ±10 VDC @ max 14 mA minimum load resistance 700 Ω			
Pressure/Force transducer power supply (only for SF, SL)	+24VDC @ 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			

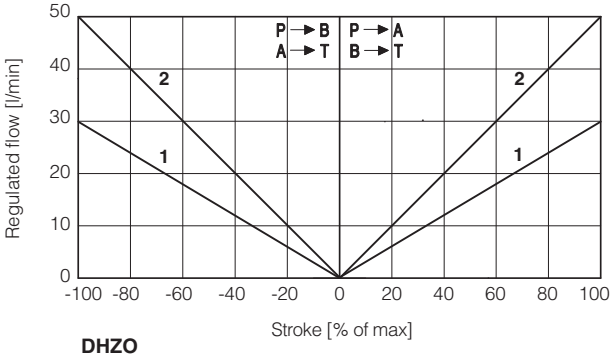
Note: a maximum time of 800 ms (depending on communication type) have be considered between the axis card energizing with the 24 VDC power supply and when the valve is ready to operate. During this time the current to the valve coils is switched to zero.

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

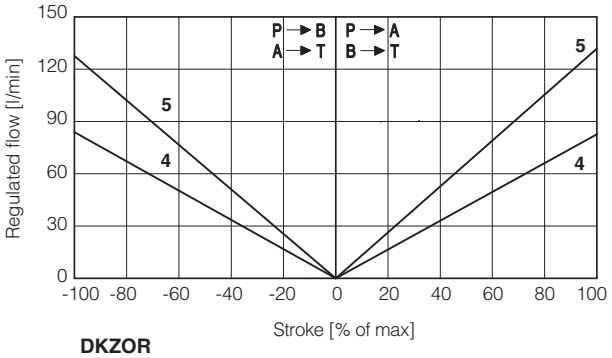
Seals, recommended fluid temperature		NBR seals (standard) = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C		
Recommended viscosity		20÷100 mm²/s - max allowed range 15 ÷ 380 mm²/s		
Max fluid contamination level	normal operation	ISO4406 class 18/16/13 NAS1638 class 7		see also filter section at 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

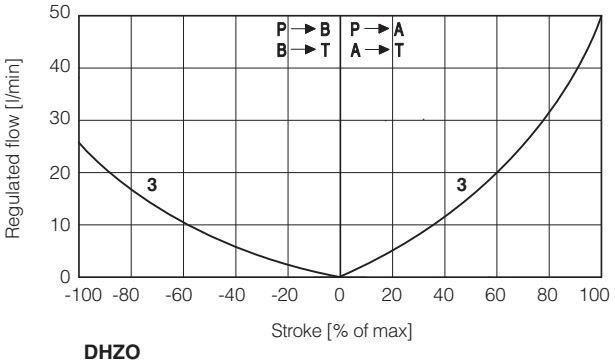
12.1 Regulation diagrams (values measure at Δp 30 bar P-T)



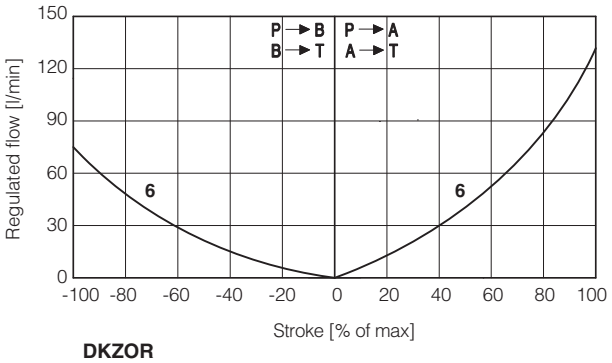
DHZO
1 = L3 **2** = L5



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

12.2 Flow /Δp diagrams

stated at 100% of valve stroke

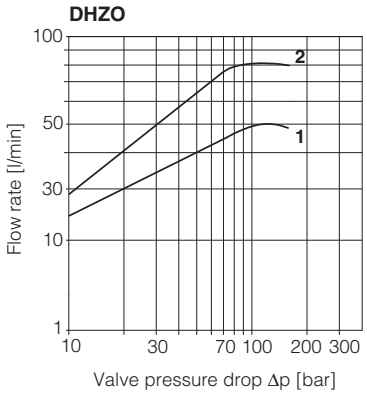
DHZO

1 = spool L3,
2 = spool L5, D5

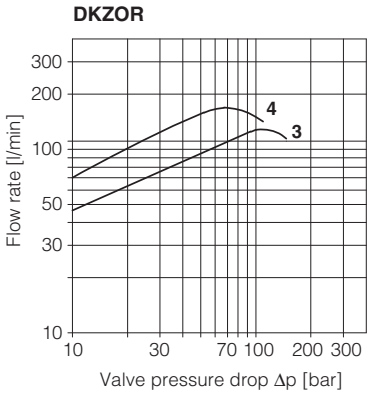
DKZOR

3 = spool L3
4 = spool L5, D5

DHZO



DKZOR



12.3 Operating limits

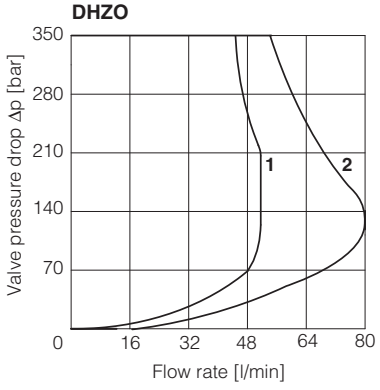
DHZO

1 = spool L3
2 = spool L5, D5

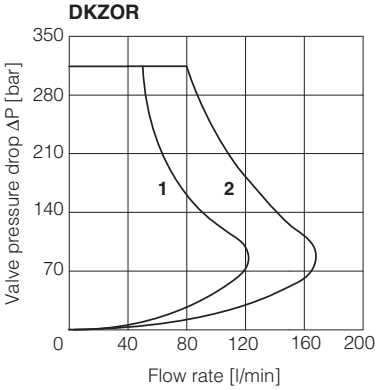
DKZOR

3 = spool L3
4 = spool L5, D5

DHZO

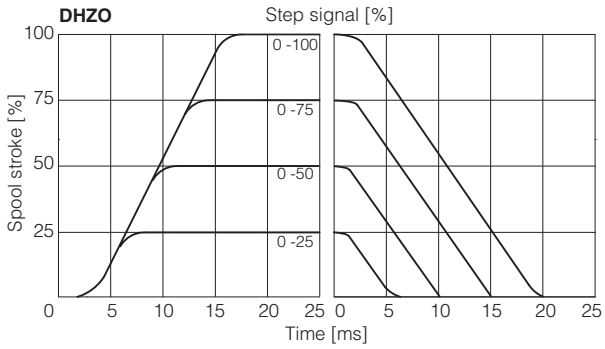


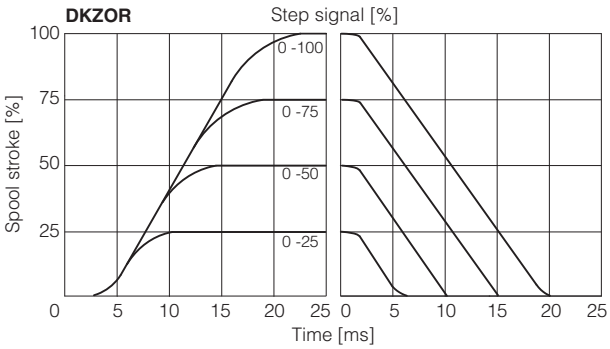
DKZOR



12.4 Response time

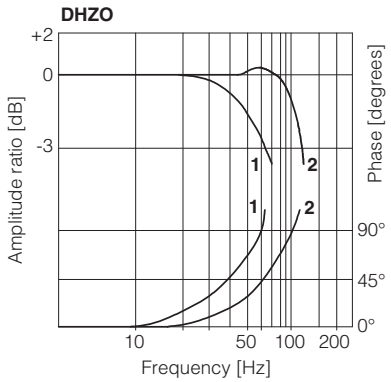
The response times in below diagrams are measured at different steps of the reference input signal. They have to be considered as average values.
For valves with on-board digital driver + axis card the dynamics performances can be optimized by setting the internal software parameters.

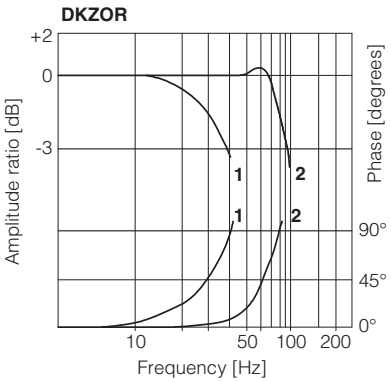




12.5 Bode diagrams

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

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 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 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 VDC	+24 VDC	+5 VDC / +24 VDC	+5 VDC / +24 VDC	+24 VDC
Axis card interface	±10V	0 ÷ 10V 4 ÷ 20 mA	Serial SSI binary/gray	TTL 5Vpp - 150 KHz	±10 VDC 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 VDC	Input - power supply
2	**V0**	Power supply 0 VDC	Gnd - power supply
3	**ENABLE**	Enable (24 VDC) or disable (0 VDC) the axis card, referred to VL0	Input - on/off signal
4	**P_INPUT+**	Position reference input signal: ±10 VDC / ±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 VDC / ±20 mA maximum range, referred to VL0	Output - analog signal **Software selectable**
7	**F_INPUT+**	Force reference input signal (SF, SL controls): ±10 VDC / ±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 VDC / ±20mA maximum range, referred to VL0	Output - analog signal **Software selectable**
9	**VL+**	Power supply 24 VDC for axis card logic and communication	Input - power supply
10	**VL0** (1)	Power supply 0 VDC for axis card logic and communication	Gnd - power supply
11	**FAULT**	Fault (0 VDC) or normal working (24 VDC), 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

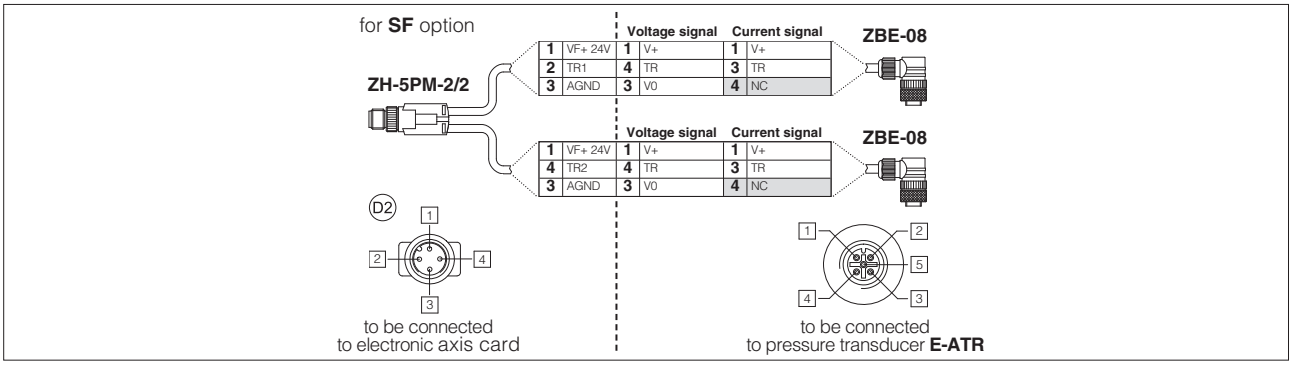
(2) Pin 2 can be fed with external +5V supply of CAN interface

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



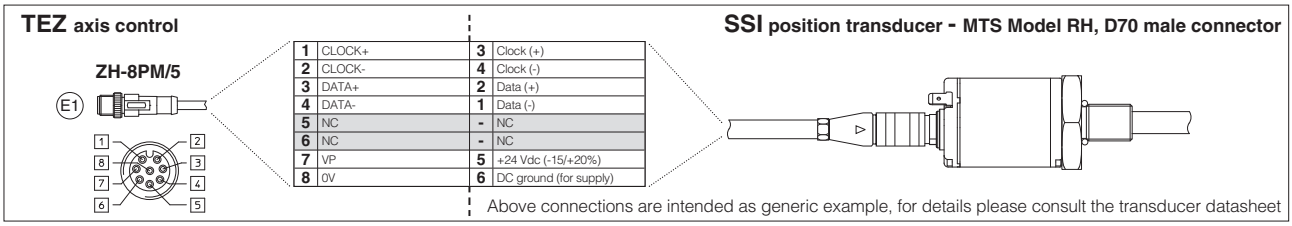
Note: pin layout always referred to axis card view

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

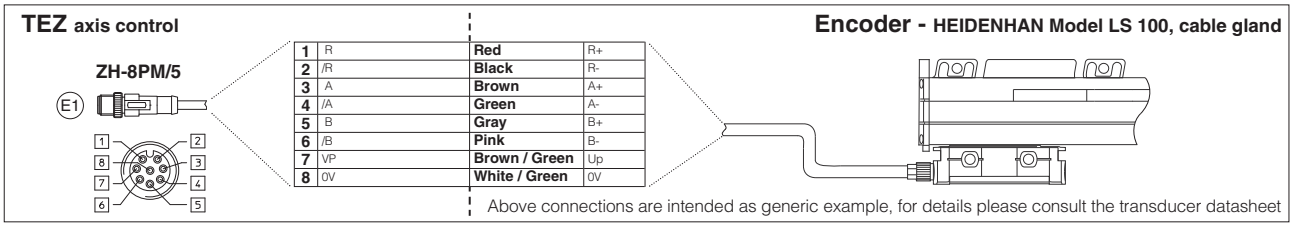
(1) Digital position transducer type is software selectable: Encoder or SSI, see 16.9

SSI connection - example



Note: pin layout referred to axis card view

Encoder connection - example



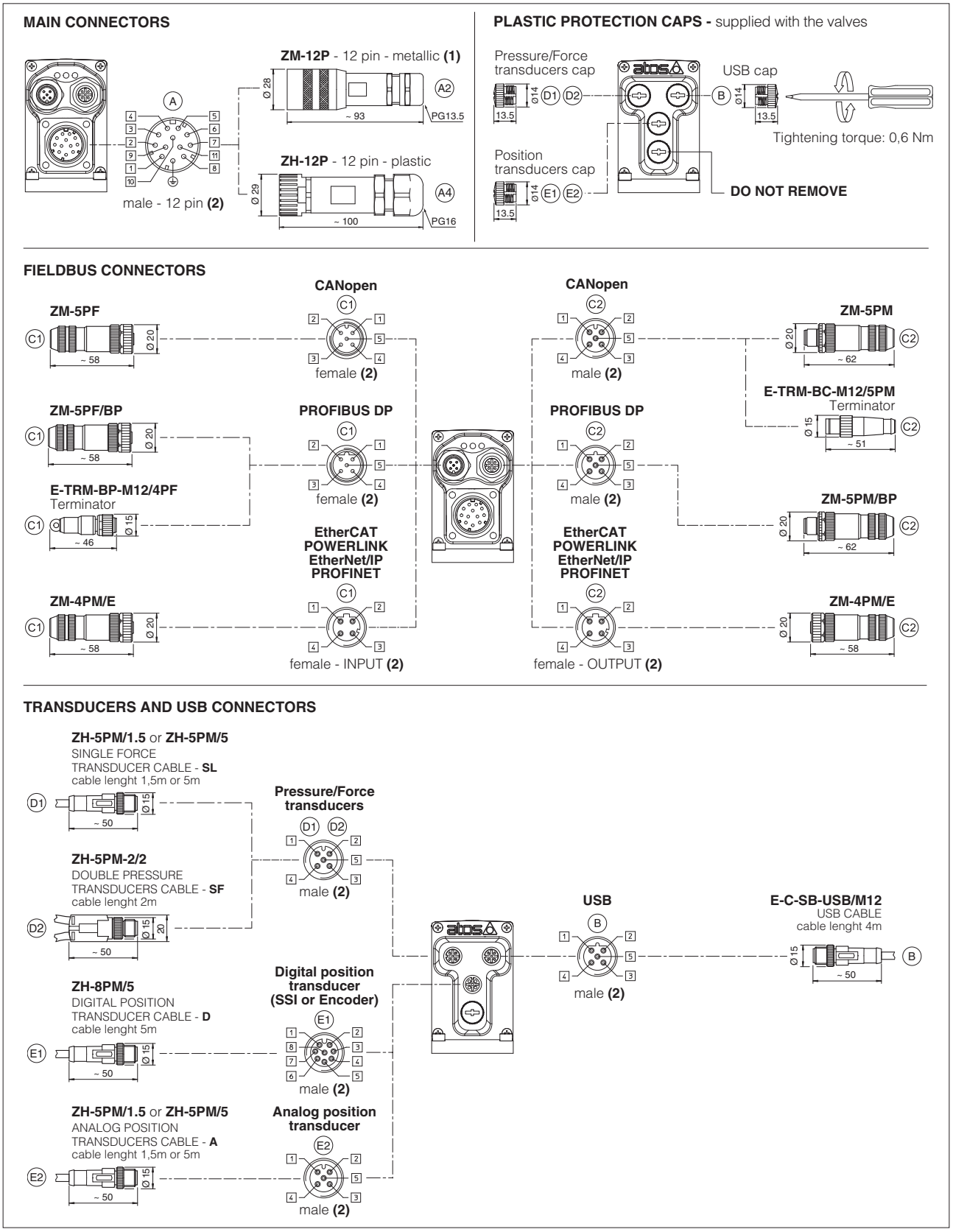
Note: pin layout referred to axis card view

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



(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)

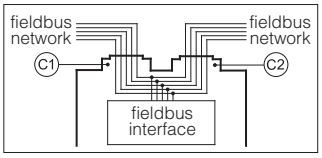
Three leds show axis card operative conditions for immediate basic diagnostics. Please refer to the axis card user manual for detailed information.

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

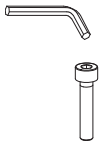
Allow to modify the valve regulation to match the actuator/system characteristics and to obtain the best overall performances:

- *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

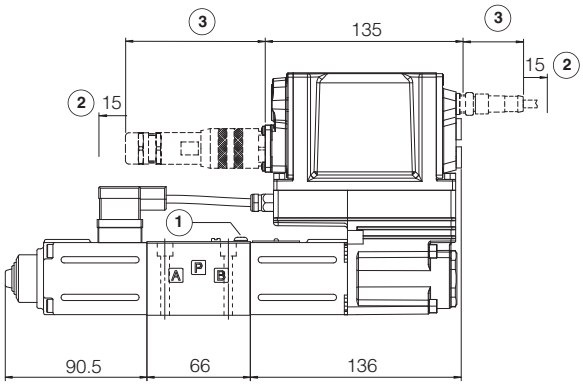
	DHZO	**DKZOR**
	**Fastening bolts:** 4 socket head screws M5x50 class 12.9 Tightening torque = 8 Nm	**Fastening bolts:** 4 socket head screws M6x40 class 12.9 Tightening torque = 15 Nm
	**Seals:** 4 OR 108; Diameter of ports A, B, P, T: Ø 7,5 mm (max) 1 OR 2025 Diameter of port Y: Ø = 3,2 mm (only for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

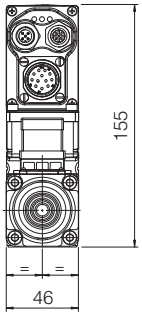
23 INSTALLATION DIMENSIONS [mm]

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



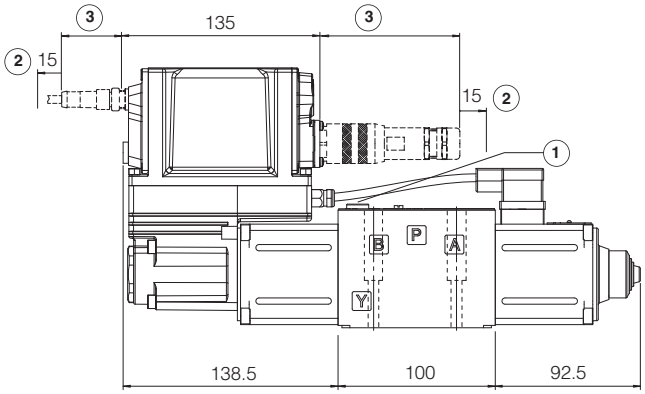


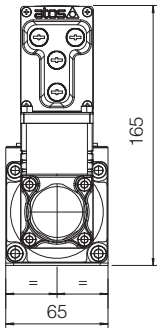
(1) = Air bleeding 3
(2) = Space to remove the connectors
(3) = The dimensions of all connectors must be considered, see section 18.6

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





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

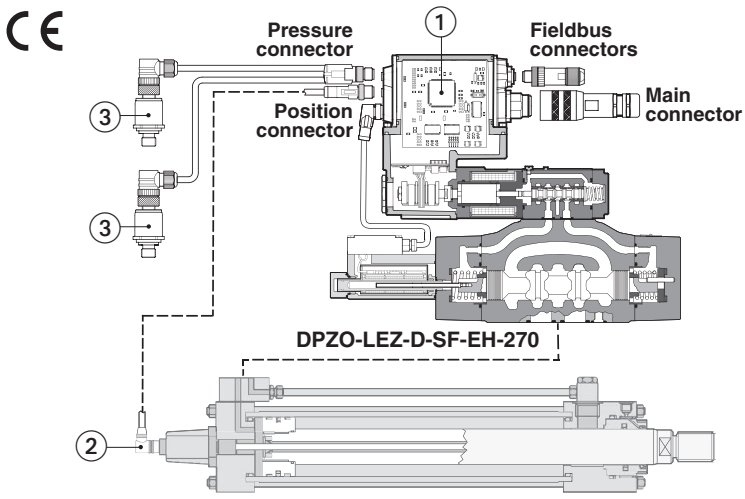
Note: for option /B the proportional solenoid, the LVDT transducer and the on-board digital driver + axis card are at side of port A

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		

Digital servoproportionals with on-board axis card

piloted, single solenoid, with two LVDT transducers and zero spool overlap



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

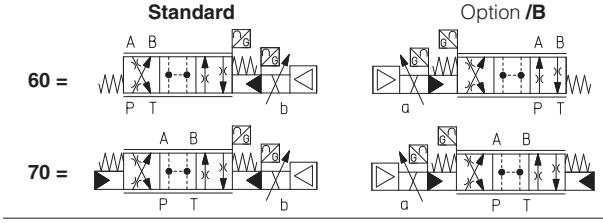
Position transducer type:
A = Analog (standard, potentiometer)
D = Digital (SSI, Encoder)

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
BP = PROFIBUS DP
EH = EtherCAT
EW = POWERLINK
EI = EtherNet/IP
EP = PROFINET RT/IRT

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

Configuration:



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

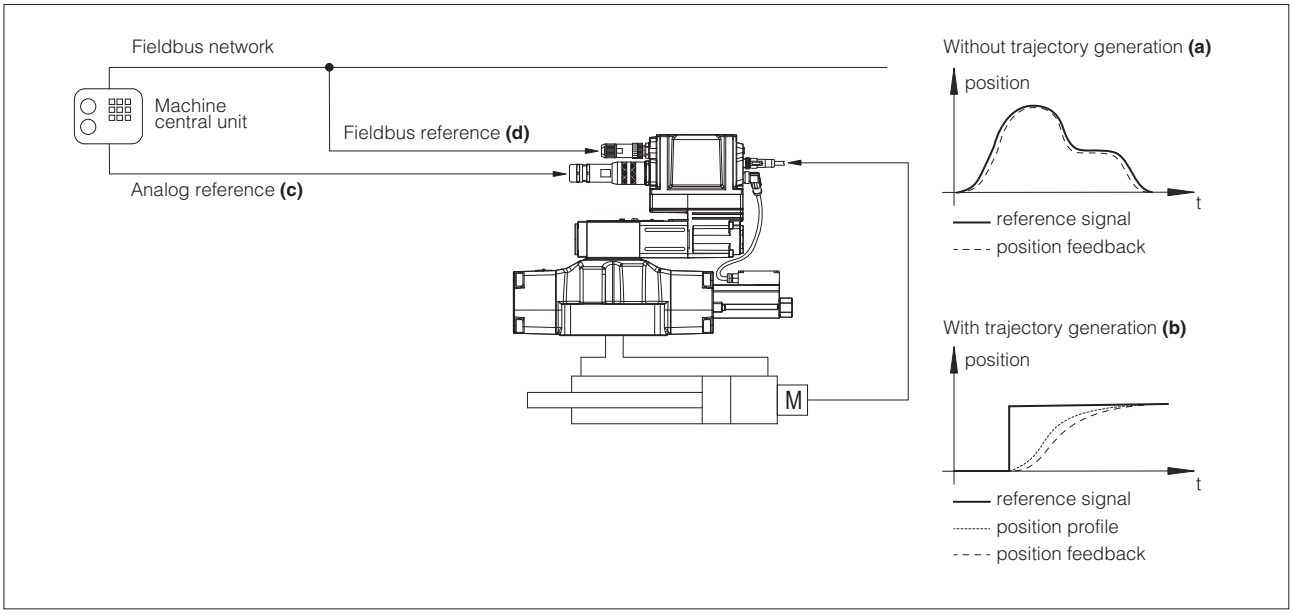
Axis card controls in closed loop the actuator position according to a reference signal from the machine central unit.

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)**.

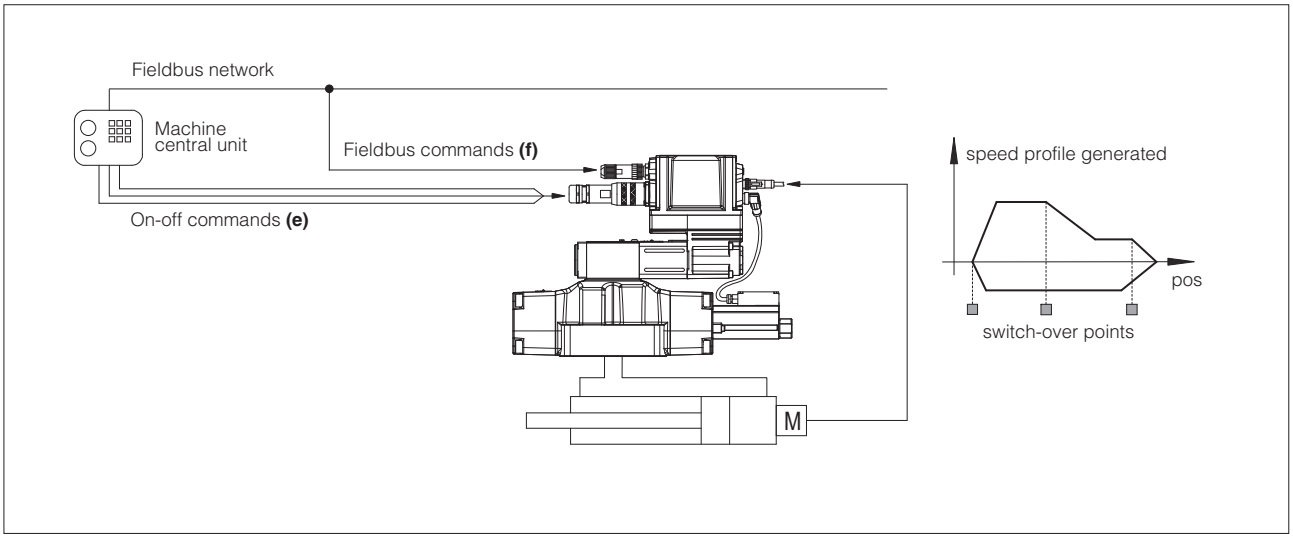
Refer to the axis card user manual for further details on position control features.



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

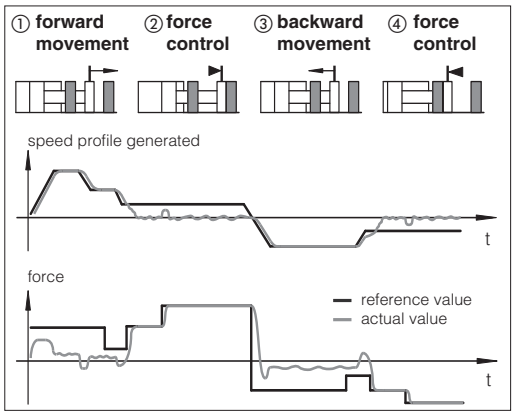
SF and **SL** controls add the alternated force closed loop control to the actuator standard position control. Pressure or force remote transducers have to be installed on the actuator and interfaced to the valve, see below functional schemes.

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.

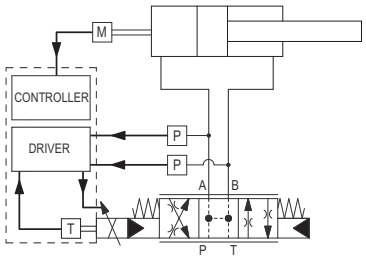
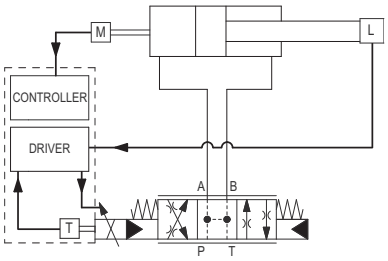
The dynamics of the switching between the two controls can be regulated thanks to specific software setting, in order to avoid instability and vibrations.

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.



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

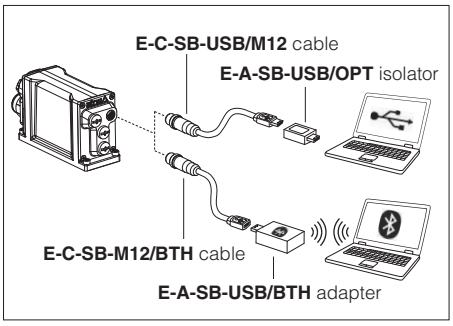
Valve's functional parameters and configurations, can be easily set and optimized using Atos Z-SW programming software connected via USB port to the digital axis card (see table **FS900**).
For fieldbus versions, the software permits valve's parameterization through USB port also if the axis card is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

USB or Bluetooth connection



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**

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 VDC Rectified and filtered : VRMS = 20 ÷ 32 VMAX (ripple max 10 % VPP)			
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 VDC (24 VMAX tollerant) Input impedance: Ri > 50 kΩ Current: range ±20 mA Input impedance: Ri = 500 Ω			
Monitor outputs	Output range: voltage ±10 VDC @ max 5 mA current ±20 mA @ max 500 Ω load resistance			
Enable input	Range: 0 ÷ 5 VDC (OFF state), 9 ÷ 24 VDC (ON state), 5 ÷ 9 VDC (not accepted); Input impedance: Ri > 10 kΩ			
Fault output	Output range: 0 ÷ 24 VDC (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 VDC @ max 100 mA and +5 VDC @ max 100 mA are software selectable; ±10 VDC @ max 14 mA minimum load resistance 700 Ω			
Pressure/Force transducer power supply (only for SF, SL)	+24VDC @ 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			

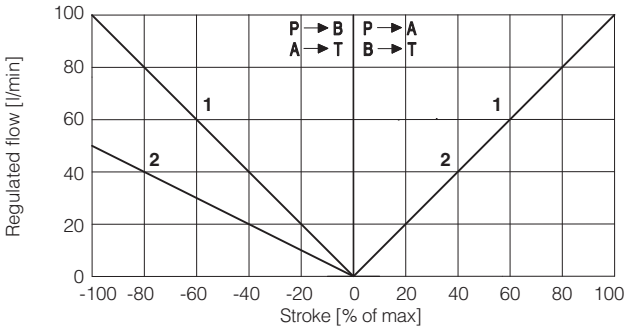
Note: a maximum time of 800 ms (depending on communication type) have be considered between the axis card energizing with the 24 VDC power supply and when the valve is ready to operate. During this time the current to the valve coils is switched to zero.

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

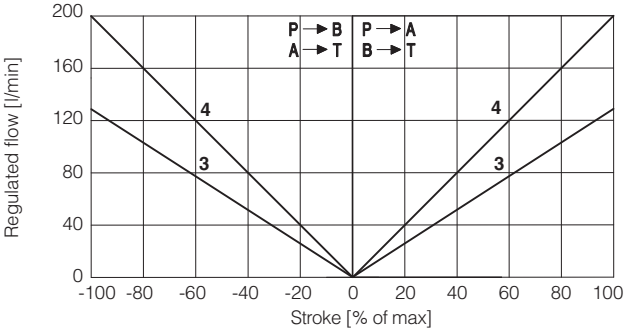
Seals, recommended fluid temperature		NBR seals (standard) = -20°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C FKM seals (/PE option) = -20°C ÷ +80°C HNBR seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -40°C ÷ +50°C		
Recommended viscosity		20÷100 mm²/s - max allowed range 15 ÷ 380 mm²/s		
Max fluid contamination level	normal operation	ISO4406 class 18/16/13 NAS1638 class 7	see also filter section at 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)

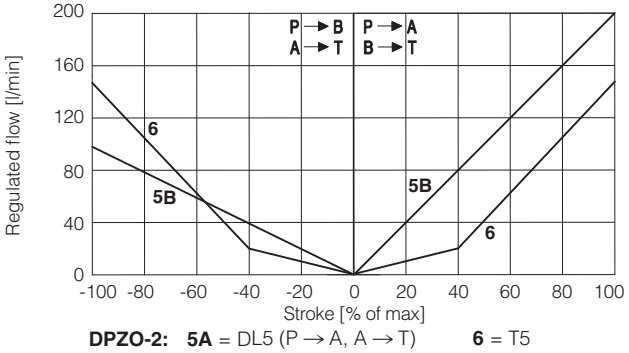
12.1 Regulation diagrams (values measure at Δp 10 bar P-T)



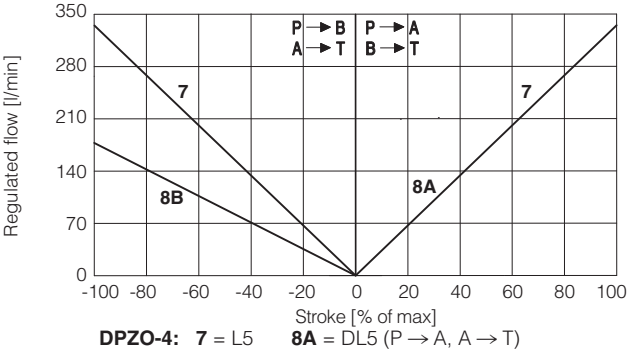
DPZO-1: **1** = L5 **2** = DL5



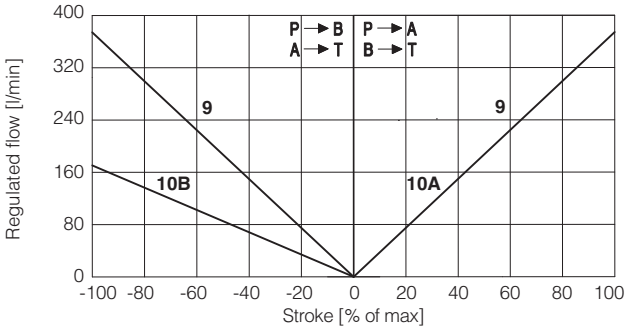
DPZO-2: **3** = L3 **4** = L5



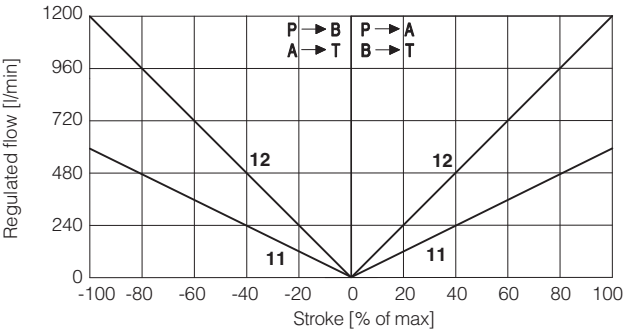
DPZO-2: **5A** = DL5 (P → A, A → T) **6** = T5
5B = DL5 (P → B, B → T)



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

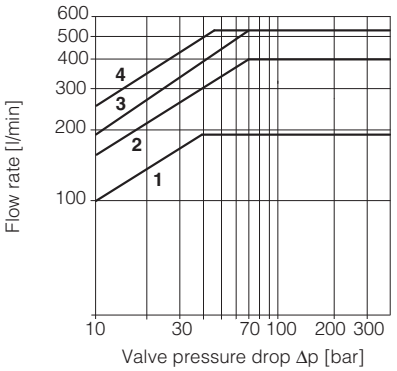


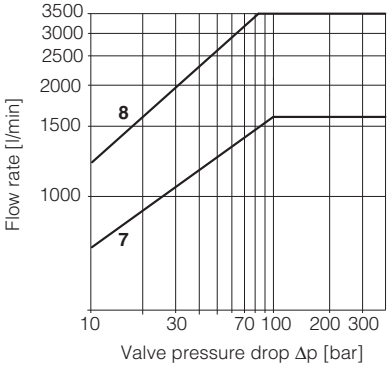
DPZO-4M: **9** = L5 **10A** = DL5 (P → A, A → T)
10B = DL5 (P → B, B → T)

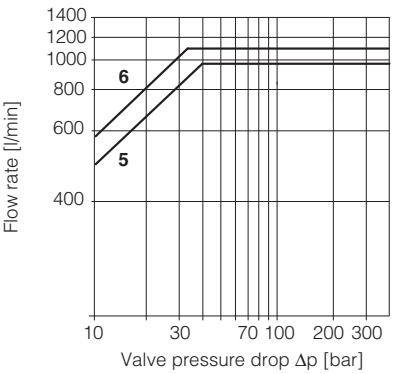


DPZO-6: **11** = L5
DPZO-8: **12** = L5

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

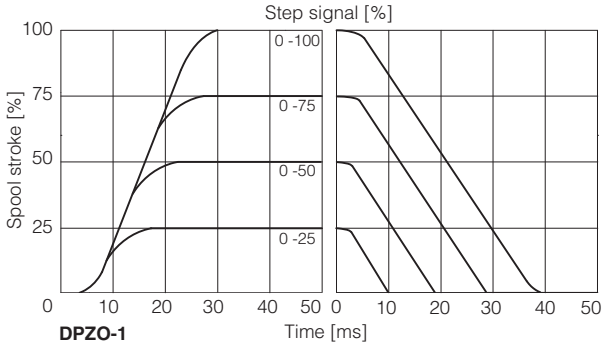
Note: Hydraulic configuration vs. reference signal for configurations 60 and 70 (standard and option /B)

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

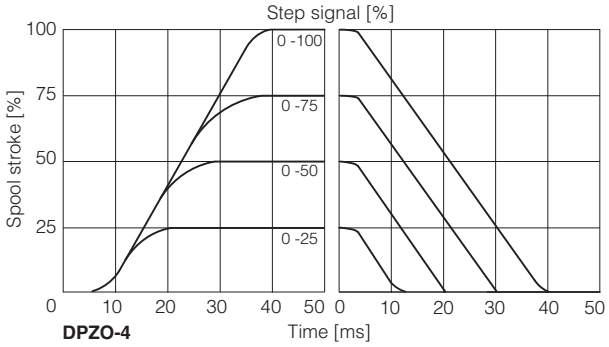
Reference signal $\begin{matrix}0 \div -10\ V \\ 4 \div 12\ mA\end{matrix}\Big\}$ P → B / A → T

12.3 Response time

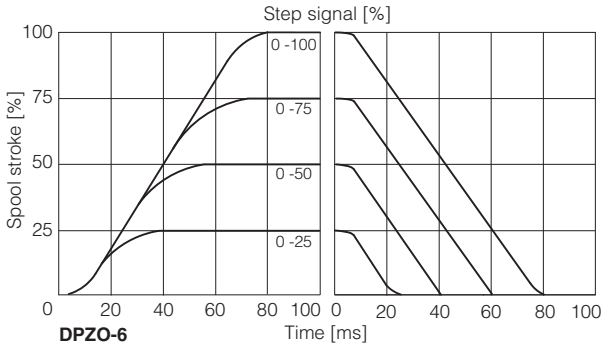
The response times in below diagrams are measured at different steps of the reference input signal. They have to be considered as average values. For valves with on-board digital driver + axis card the dynamics performances can be optimized by setting the internal software parameters.



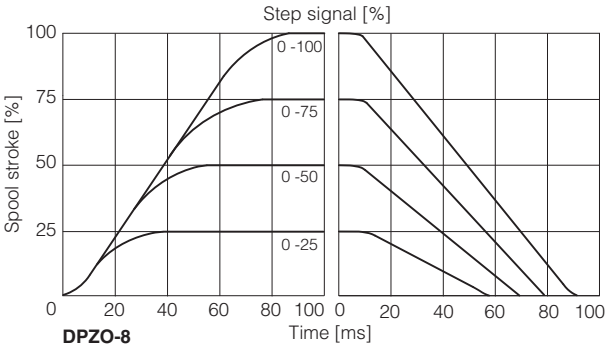
DPZO-1
DPZO-2



DPZO-4
DPZO-4M



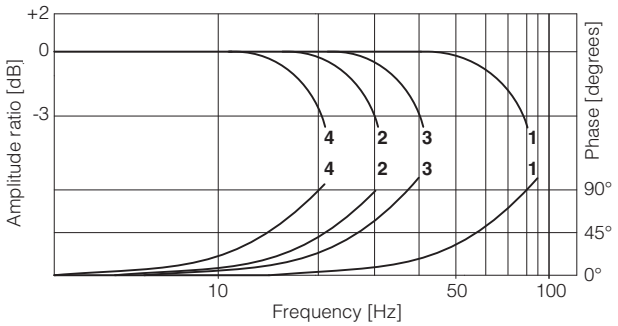
DPZO-6

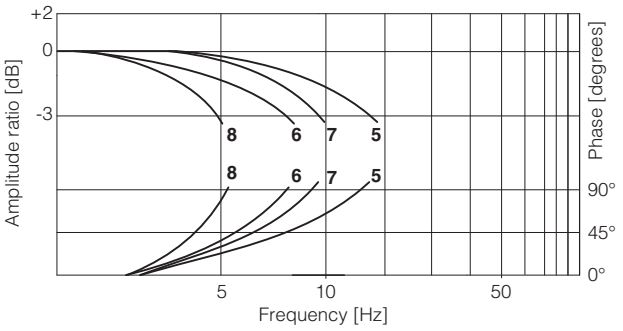


DPZO-8

12.4 Bode diagrams

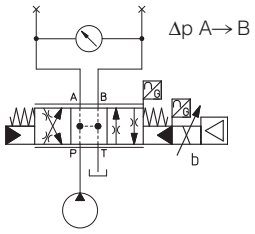
Stated at nominal hydraulic conditions.





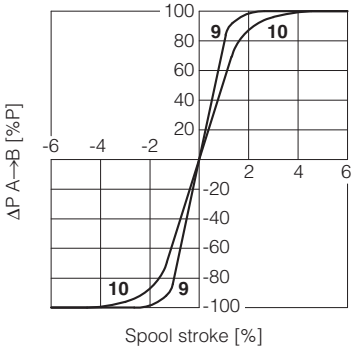
1 = DPZO-1 / DPZO-2 } ± 5%
2 = DPZO-1 / DPZO-2 } ± 100%
3 = DPZO-4 / DPZO-4M } ± 5%
4 = DPZO-4 / DPZO-4M } ± 100%
5 = DPZO-6 ± 5%
6 = DPZO-6 ± 100%
7 = DPZO-8 ± 5%
8 = DPZO-8 ± 100%

12.5 Pressure gain



9 = DPZO-1

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



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.

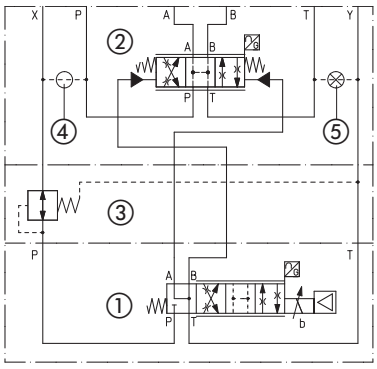
G = Pressure reducing valve ③ with fixed setting, installed between pilot valve and main body. Reduced pressure setting:

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 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.

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 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.

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 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.

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 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.

15.7 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)

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 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.

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 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 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 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 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 VDC	+24 VDC	+5 VDC / +24 VDC	+5 VDC / +24 VDC	+24 VDC
Axis card interface	±10V	0 ÷ 10V 4 ÷ 20 mA	Serial SSI binary/gray	TTL 5Vpp - 150 KHz	±10 VDC 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 (A)

PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
1	**V+**	Power supply 24 VDC	Input - power supply
2	**V0**	Power supply 0 VDC	Gnd - power supply
3	**ENABLE**	Enable (24 VDC) or disable (0 VDC) the axis card, referred to VL0	Input - on/off signal
4	**P_INPUT+**	Position reference input signal: ±10 VDC / ±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 VDC / ±20 mA maximum range, referred to VL0	Output - analog signal **Software selectable**
7	**F_INPUT+**	Force reference input signal (SF, SL controls): ±10 VDC / ±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 VDC / ±20mA maximum range, referred to VL0	Output - analog signal **Software selectable**
9	**VL+**	Power supply 24 VDC for axis card logic and communication	Input - power supply
10	**VL0** (1)	Power supply 0 VDC for axis card logic and communication	Gnd - power supply
11	**FAULT**	Fault (0 VDC) or normal working (24 VDC), 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 (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

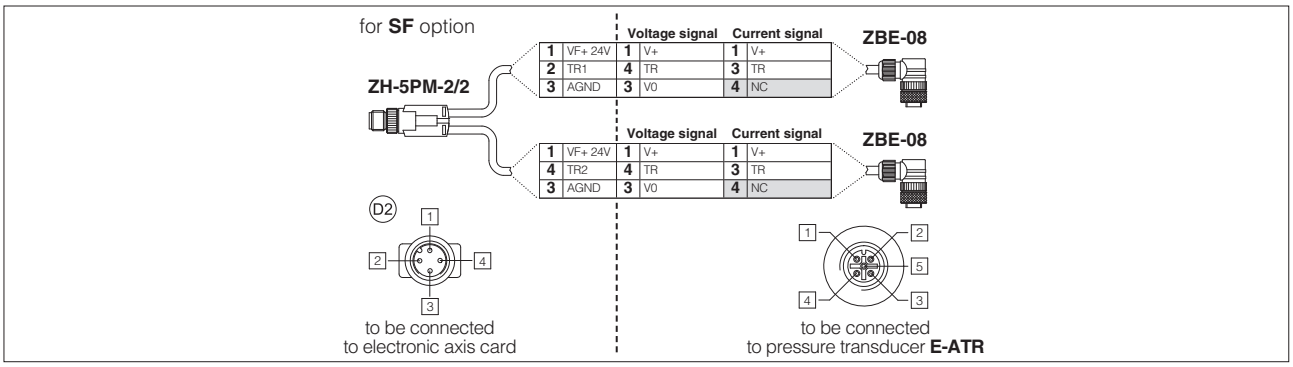
(2) Pin 2 can be fed with external +5V supply of CAN interface

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



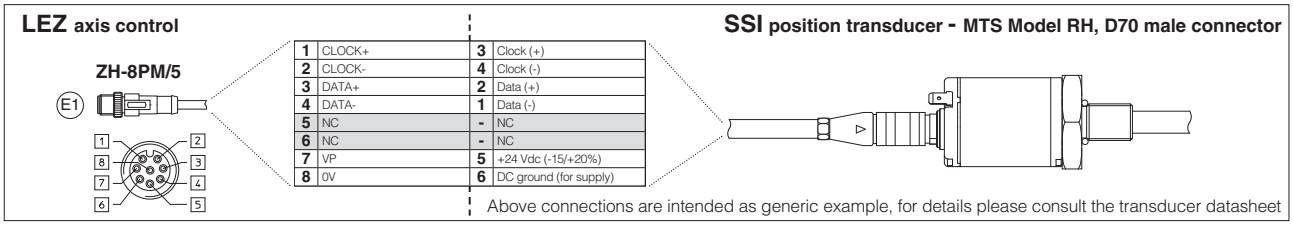
Note: pin layout always referred to axis card view

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

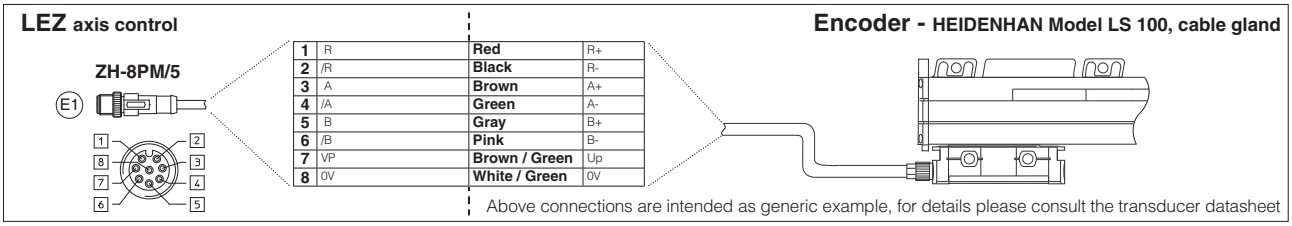
(1) Digital position transducer type is software selectable: Encoder or SSI, see 15.9

SSI connection - example



Note: pin layout referred to axis card view

Encoder connection - example



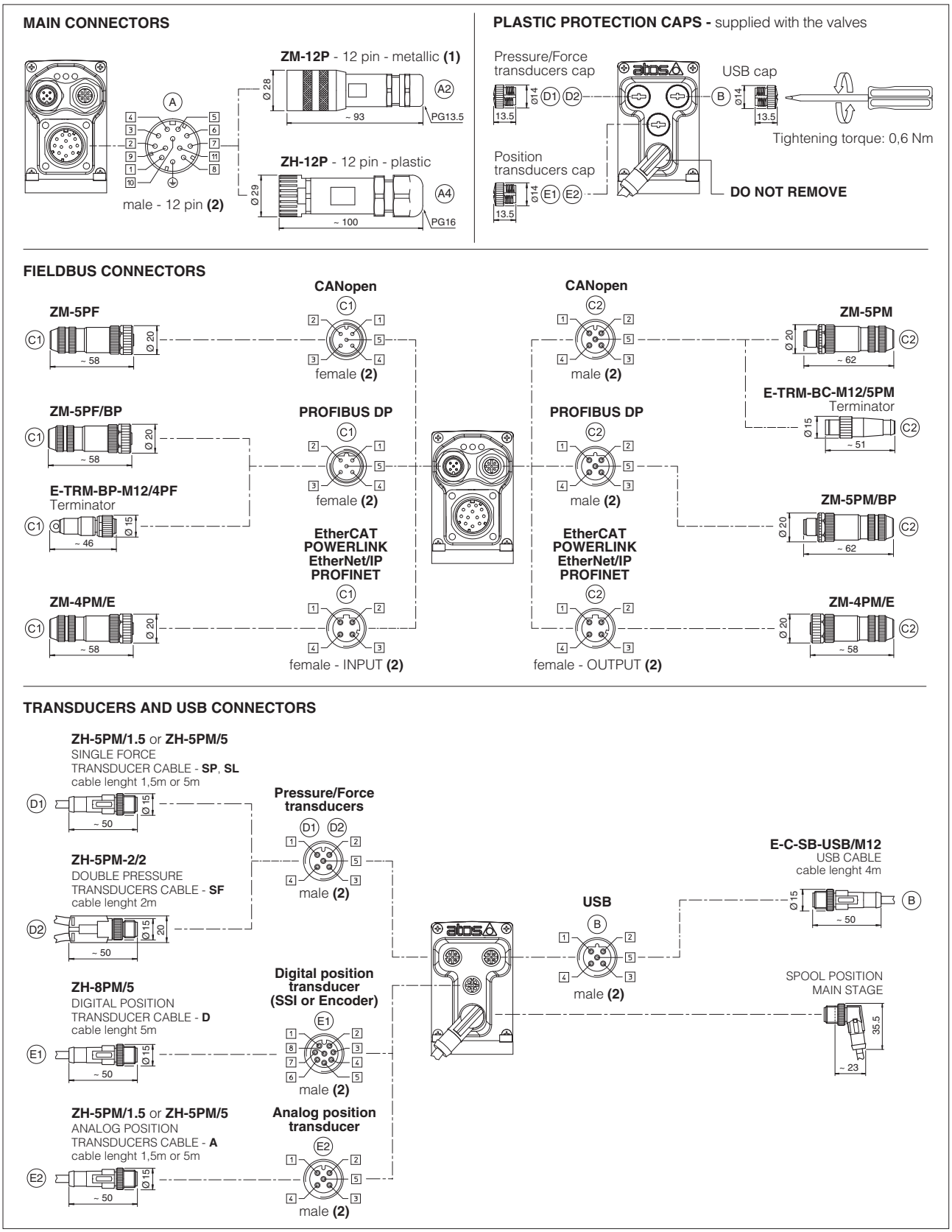
Note: pin layout referred to axis card view

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

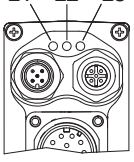
17.6 LEZ connections layout



(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)

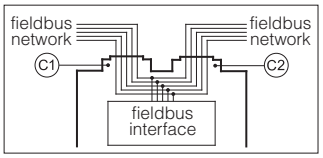
Three leds show axis card operative conditions for immediate basic diagnostics. Please refer to the axis card user manual for detailed information.

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

18 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



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).

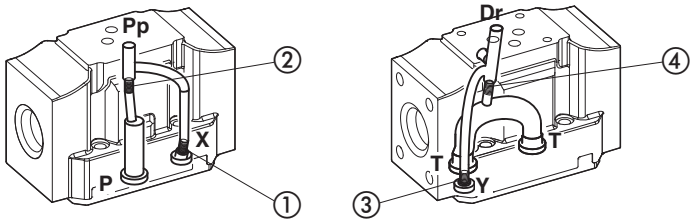
21 FASTENING BOLTS AND SEALS

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

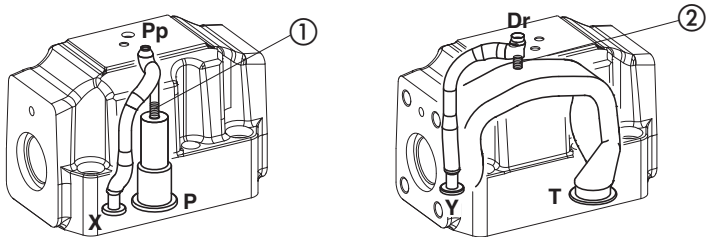
Depending on the position of internal plugs, different pilot/drain configurations can be obtained as shown below.
To modify the pilot/drain configuration, proper plugs must only be interchanged. The plugs have to be sealed using loctite 270.
Standard valves configuration provides internal pilot and external drain.

DPZO-1 **Pilot channels** **Drain channels**



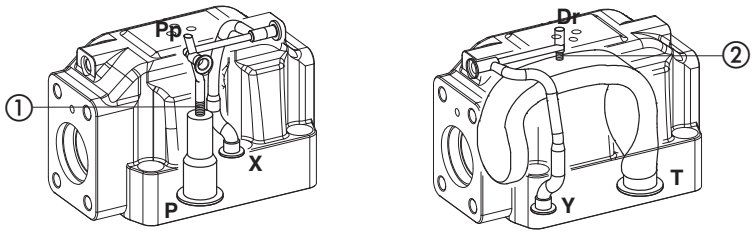
Internal piloting: blinded plug SP-X300F ① in X;
External piloting: blinded plug SP-X300F ② in Pp;
Internal drain: blinded plug SP-X300F ③ in Y;
External drain: blinded plug SP-X300F ④ in Dr.

DPZO-2 **Pilot channels** **Drain channels**



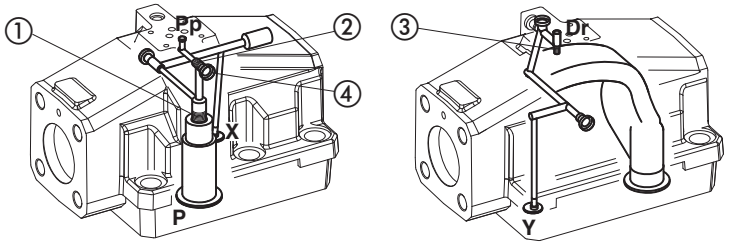
Internal piloting: Without blinded plug SP-X300F ①;
External piloting: Add blinded plug SP-X300F ①;
Internal drain: Without blinded plug SP-X300F ②;
External drain: Add blinded plug SP-X300F ②.

DPZO-4 **Pilot channels** **Drain channels**



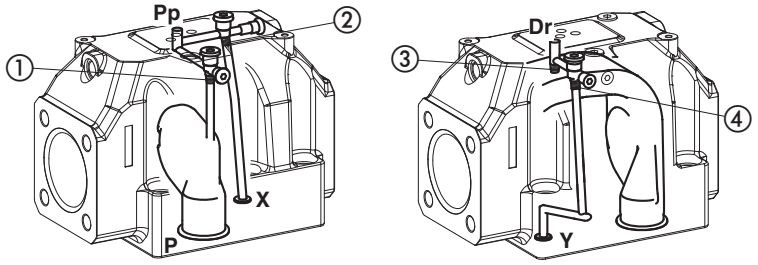
Internal piloting: Without blinded plug SP-X500F ①;
External piloting: Add blinded plug SP-X500F ①;
Internal drain: Without blinded plug SP-X300F ②;
External drain: Add blinded plug SP-X300F ②.

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**

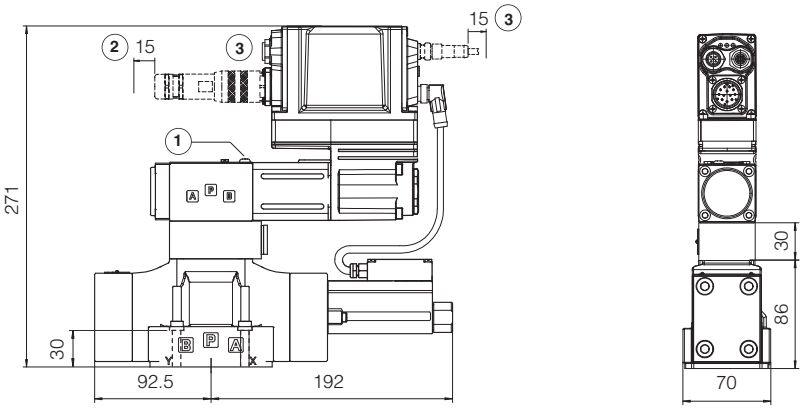


Internal piloting: Without plug ①;
External piloting: Add NPTF 1/8 in pos ①;
plug NPTF 1/8 in pos ②;
Internal drain: Without plug NPTF 1/8 in pos ③;
Add plug NPTF 1/8 in pos ④;
External drain: Add plug NPTF 1/8 in pos ③.

DPZO-LEZ-*-1

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

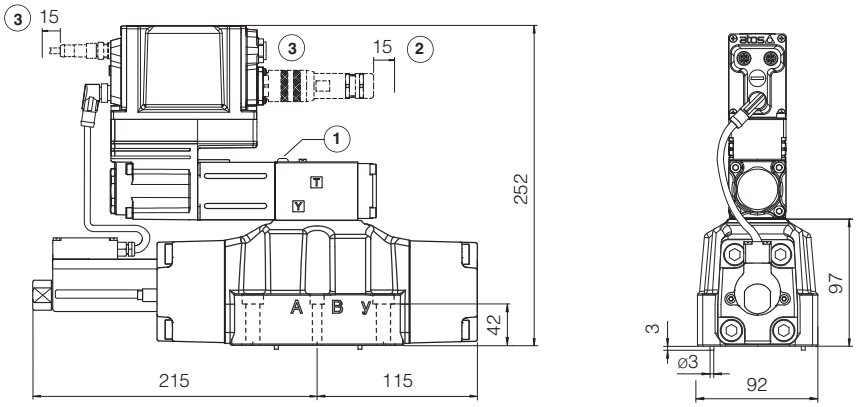
Mass [kg]	
DPZO-*-1	9,5



DPZO-LEZ-*-2

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

Mass [kg]	
DPZO-*-2	14



(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

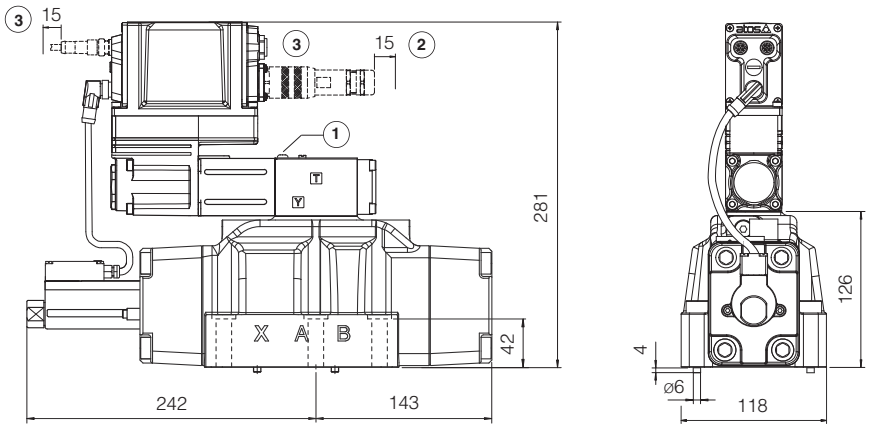
DPZO-LEZ-*-4

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

Mass [kg]	
DPZO-*-4*	19

DPZO-LEZ-*-4M

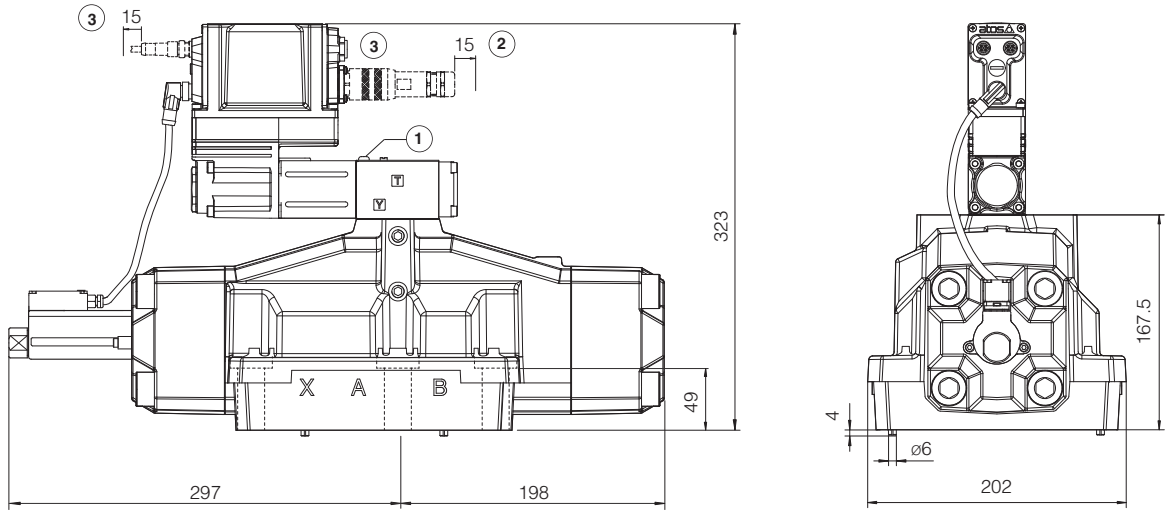
ISO 4401: 2005
Mounting surface: 4401-08-08-0-05(see table P005)
ports A, B, P, T Ø 32mm



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

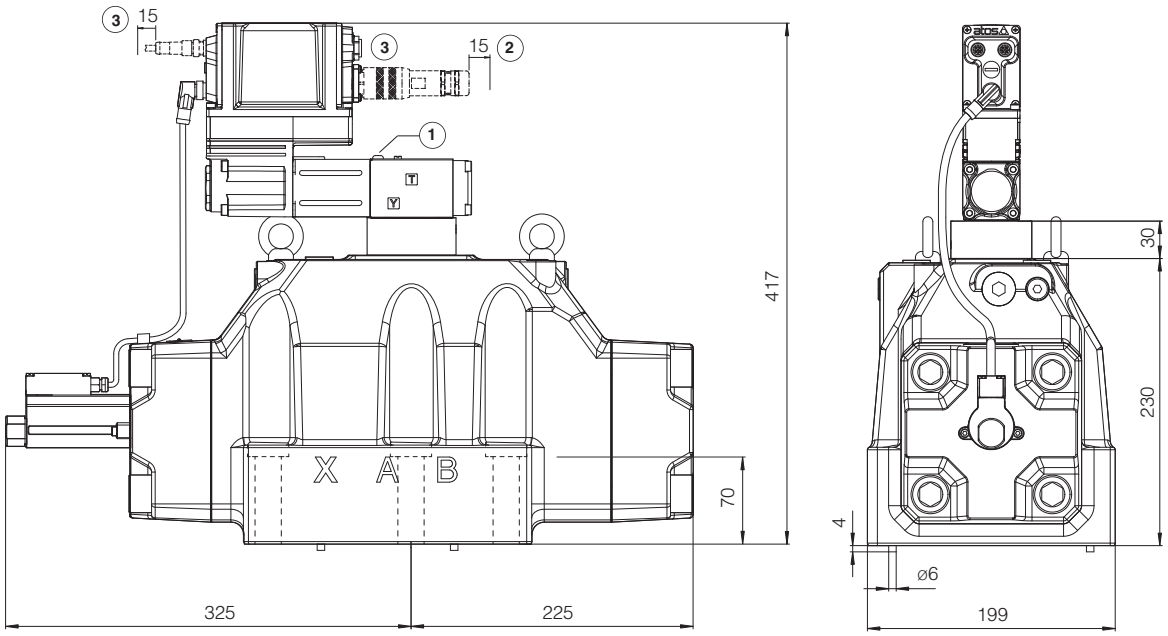
(3) = The dimensions of all connectors must be considered, see section 18.6

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

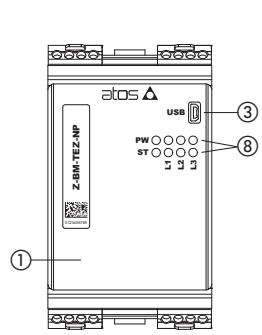
Notes: the overall height is increased by 40 mm for /G option (0,9 kg);
for option /B the proportional solenoid, the LVDT transducer and the on-board digital driver + axis card are at side of port B of the main stage

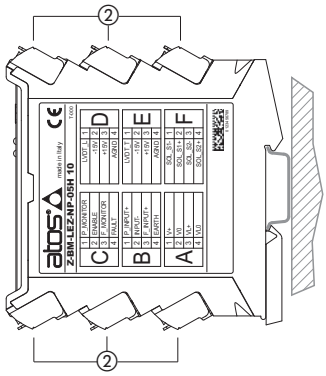
24 RELATED DOCUMENTATION

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		

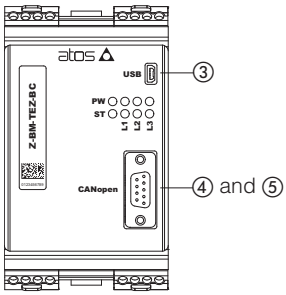
Digital Z-BM-TEZ/LEZ axis cards with driver functionality

DIN-rail format, for position and force controls

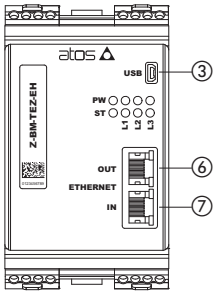




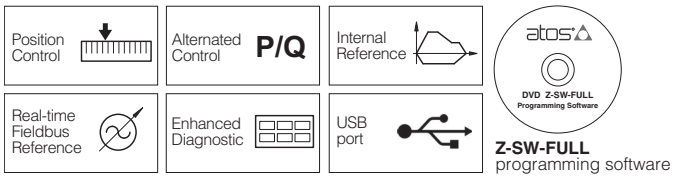
Z-BM-TEZ- **NP** Not Present



Z-BM-TEZ- **BC** CANopen
BP PROFIBUS DP



Z-BM-TEZ- **EH** EtherCAT
EW POWERLINK
EI EtherNet/IP
EP PROFINET RT/IRT



Z-SW-FULL
programming software

Connectors ② included

Z-BM-TEZ/LEZ

Digital axis cards ① perform the driver functions for proportional valves plus the position closed loop control of the linear or rotative actuator to which the proportional valve is connected.
Z-BM-TEZ execution controls direct and pilot operated directional valves with one LVDT transducer.
Z-BM-LEZ execution controls directional pilot operated valves with two LVDT transducers.
The controlled actuator has to be equipped with transducer (analog, SSI or Encoder) to read the axis position feedback.
The axis card can be operated via an external reference signal or automatic cycle, see section 4.
A force alternated control may be set by software additionally to the position control: a pressure/force transducer has to be assembled into the actuator and connected to the axis card; a second pressure/force reference signal is required.
Atos PC software allows to customize the axis card configuration to the specific application requirements.

Electrical Features:

- up to 11 fast plug-in connectors ②
- Mini USB port ③ always present
- DB9 fieldbus communication connector ④ for CANopen and ⑤ PROFIBUS DP
- RJ45 ethernet communication connectors ⑥ output and ⑦ input for EtherCAT, POWERLINK, EtherNet/IP, PROFINET
- 8 leds for diagnostics ⑧ (see 8.1)
- Electrical protection against reverse polarity of power supply
- Operating temperature range: -20 ÷ +50 °C
- Plastic box with IP20 protection degree and standard DIN-rail mounting
- CE mark according to EMC directive

Software Features:

- Intuitive graphic interface
- Internal generation of motion cycle
- Setting of axis dynamic response (PID) to optimize the application performances
- Setting of valve's functional parameters: bias, scale, ramps, dither
- Linearization function for hydraulic regulation
- Complete diagnostics of axis status
- Internal oscilloscope function
- In field firmware update through USB port

1 MODEL CODE

Z-BM	-	TEZ	-	NP	-	01H	/	*	*	/	*

Z-BM — Off-board electronic axis card in DIN rail format

TEZ = digital full driver + axis card, for valves with one LVDT transducer
LEZ = digital full driver + axis card, for valves with two LVDT transducers

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

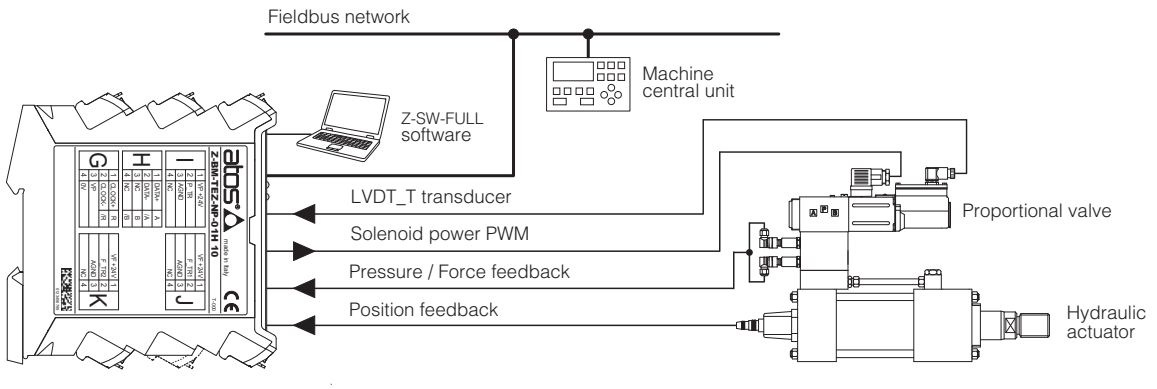
01H = for single solenoid proportional valves
05H = for double solenoid proportional valves (only for **TEZ**)

Options, see section 3 **:**
A = max current limitation for Ex-proof valves
C = current feedback 4 ÷ 20 mA for LVDT transducers, only in combination with option A

Series number

Set code (see section 9)

2 BLOCK DIAGRAM EXAMPLE



Note: block diagram example for alternated position/force control, with fieldbus interface

3 VALVES RANGE

Valves	Directional		
Industrial Tech table	**DHZO-T, DKZOR-T** F168	**DLHZO-T, DLKZOR-T** F180	**DPZO-L** F178
Ex-proof Tech table	-	**DLHZA-T, DLKZA-T** FX140	-
Axis card model	**Z-BM-TEZ**		**Z-BM-LEZ**

4 POSITION CONTROL

4.1 External reference signal

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

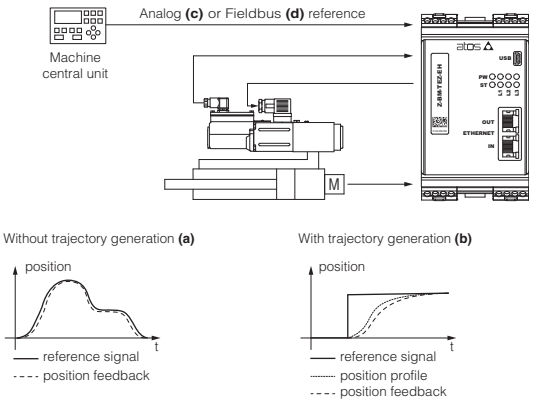
Position profile can be managed in two ways (software selectable):

- 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.

External reference signal

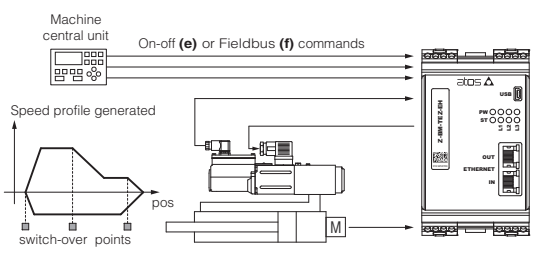


4.2 Automatic cycle

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.

Automatic cycle



5 ALTERNATED POSITION / FORCE CONTROL

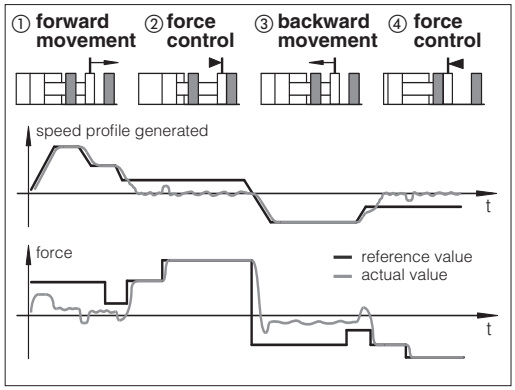
The alternated pressure or force closed loop control can be added to the actuator standard position control, requiring one or two remote transducers (pressure or force) that have to be installed on the actuator, see below functional schemes.

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.

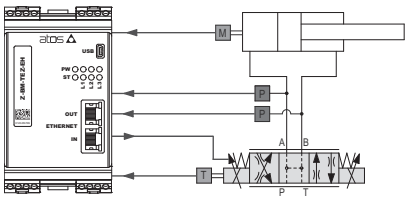
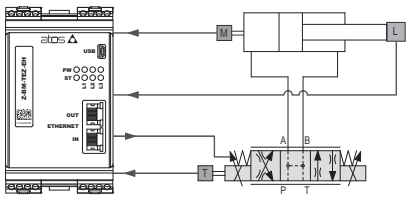
The dynamics of the switching between the two controls can be regulated thanks to specific software setting, in order to avoid instability and vibrations.

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 - software selectable

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's spool transducer M actuator's position transducer P pressure transducer L load cell

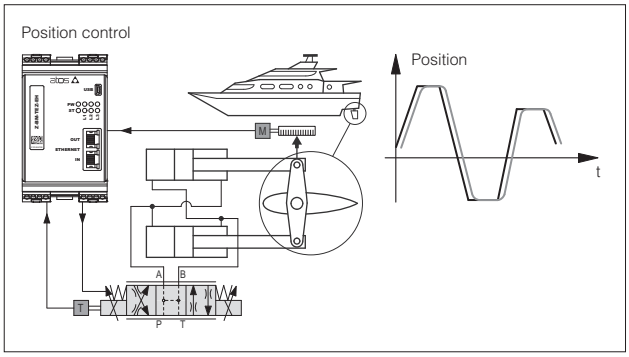
SF – position/force control
Adds force control to standard position control and permits to limit the max force in two directions controlling in closed loop the delta pressure acting on both sides of the hydraulic actuator. Two pressure transducers have to be installed on both hydraulic line.

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 hydraulic actuator.

General Notes:

- servoproportional type DLHZO, DLKZOR and DPZO-L are strongly recommended for high accuracy applications see tech tables **F180**, **F175**
- auxiliary check valves are recommended in case of specific hydraulic configuration requirements in absence of power supply or fault, see tech table **EY105**
- for additional information about alternated P/Q controls configuration please refer to tech table **FS500**
- Atos technical service is available for additional evaluations related to specific applications usage

6 APPLICATION EXAMPLES

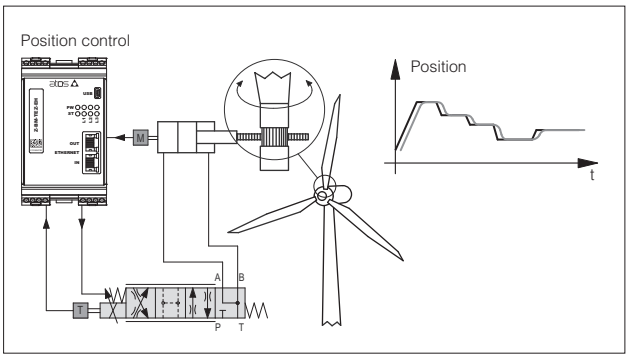


Hydraulic steering wheel in marine applications

Rudder controls on motor yachts and sail boats requires smooth control for precise and reliable operations.

Z-BM-TEZ/LEZ axis cards perform the rudder position control system, ensuring accurate and repetitive regulations for a comfortable ride, thanks to:

- analog position reference mode for real time controls
- analog position transducer for simple and compact solution
- position PID control parameters to optimize the system response
- complete diagnostic information for advanced system monitoring

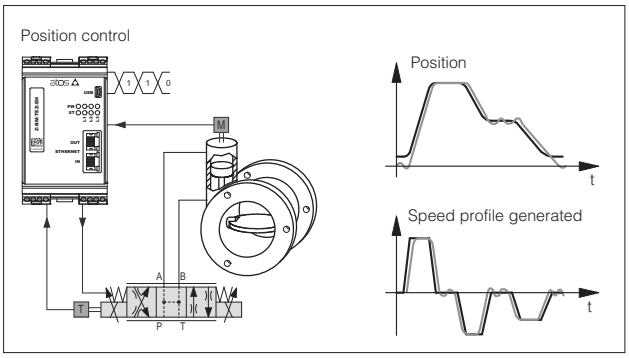


Wind turbines

The pitch control of the rotor blades is required to maximize the energy production. Accurate positioning, decentralized intelligence as well as long service life and reliability are required.

Z-BM-TEZ/LEZ axis cards perform high quality regulation of the blade pitch simplifying the system architecture, thanks to:

- SSI digital position transducer for high precision control
- complete remote system management with fieldbus interface
- position PID selection to adapt the position control to the different wind conditions

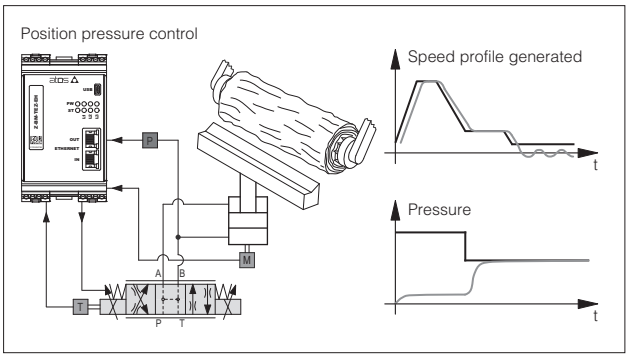


Process valves

Process valves motion regulation requires smooth and remote controls due to wide distributed applications.

Z-BM-TEZ/LEZ axis cards allow remote control, thanks to:

- internal reference generation with maximum speed and acceleration settings for standing alone axis control
- potentiometer position transducer for compact and cost effective solution
- fieldbus connection for easy parameterization and remote commands

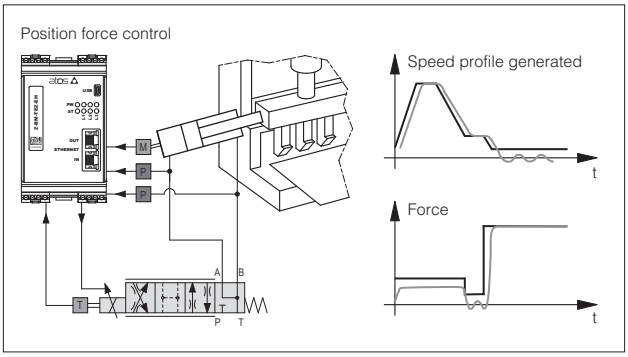


Wood machinery

Hydraulic wood machines require configurable and repetitive motion profiles, accurate position controls, and digital signals for synchronization purpose.

Z-BM-TEZ/LEZ axis cards allow remote control, thanks to:

- internal reference generation with maximum speed and acceleration settings
- analog position transducer for simple and reliable solution
- pressure transducer for alternated pressure control
- fieldbus connection for remote parameterization, commands, and axis card state indication

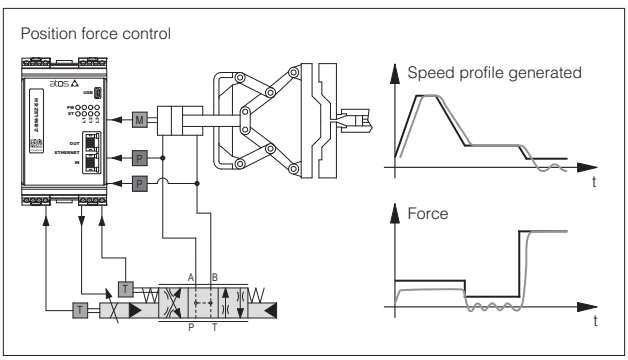


Bending Machines

Machine tools for cold-forming flat sheets require complete, automatic, programmable and flexible machine control to produce sheet metal panels from punched blank.

Z-BM-TEZ/LEZ axis cards combine high level position regulation with accurate force control to provide in a single device a complete and dedicated solution, thanks to:

- internal reference generation to simplify the machine control cycle
- digital position sensor for high resolution measurement system
- two pressure transducers for alternated force control
- fieldbus interface for easy machine control integration
- auxiliary digital outputs for system status indication (target reached, force control active)



Die-casting machinery

Clamp movements in die-casting phases involve fast/slow motion cycle with accurate and repetitive alternated position/force controls for the mould safety functions.

Z-BM-TEZ/LEZ axis cards, with alternated position/force control, simplify the hydraulic + electronic system architecture, thanks to:

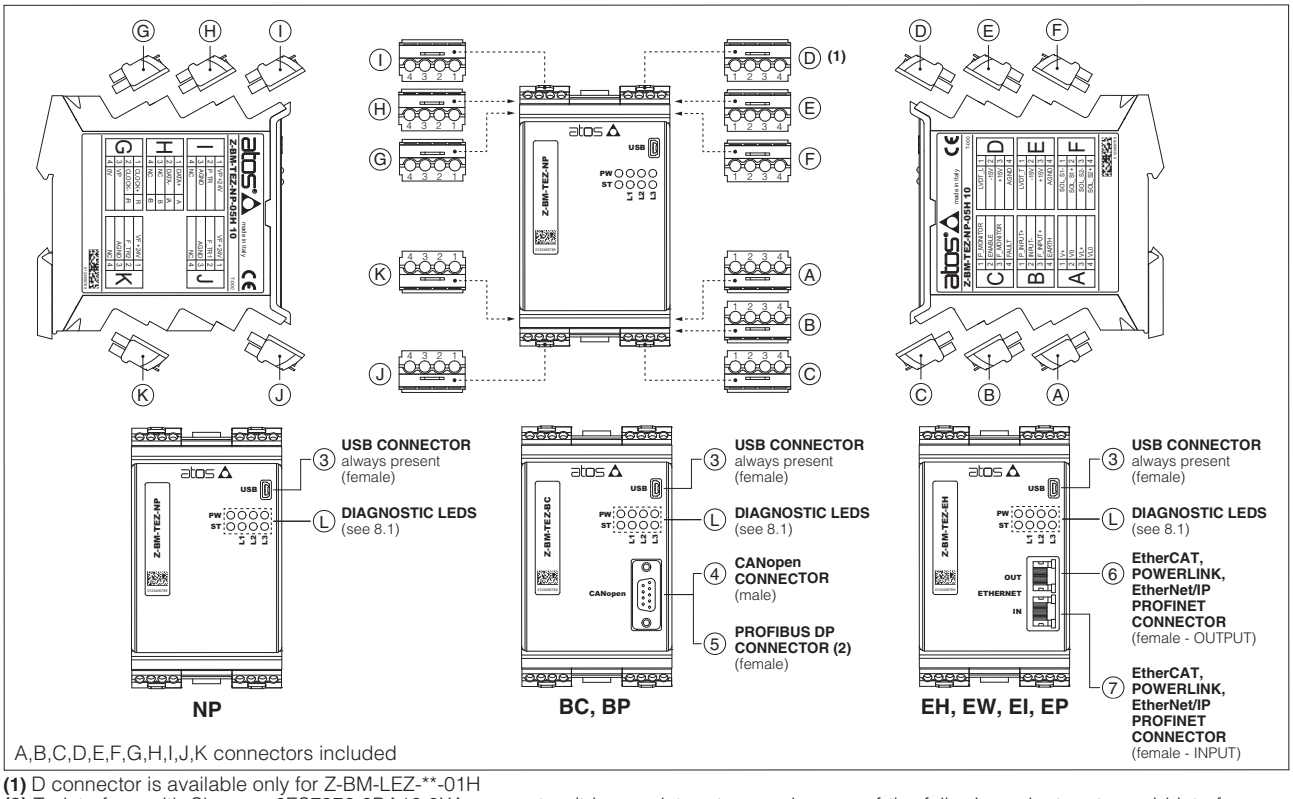
- internal reference generation for repetitive working cycles
- SSI digital position transducer for accurate axis control
- two pressure transducers for alternated force control
- auxiliary digital inputs/output to synchronize the machine functions
- fieldbus connection for machine remote control and advanced diagnostics

7 MAIN CHARACTERISTICS

Power supplies (see 10.1, 10.2)	Nominal : +24 VDC Rectified and filtered : VRMS = 20 ÷ 32 VMAX (ripple max 10 % VPP)			
Max power consumption	50 W			
Current supplied to solenoids	IMAX = 3.0 A for standard axis card IMAX = 2.5 A for ex-proof axis card (**/A option**)			
Analog input signals (see 10.3, 10.4)	Voltage: range ±10 VDC (24 VMAX tollerant) Input impedance: Ri > 50 kΩ Current: range ±20 mA Input impedance: Ri = 500 Ω			
Monitor outputs (see 10.5, 10.6)	Output range: voltage ±10 VDC @ max 5 mA current ±20 mA @ max 500 Ω load resistance			
Enable input (see 10.7)	Range: 0 ÷ 5 VDC (OFF state), 9 ÷ 24 VDC (ON state), 5 ÷ 9 VDC (not accepted); Input impedance: Ri > 10 kΩ			
Fault output (see 10.8)	Output range: 0 ÷ 24 VDC (ON state > [power supply - 2 V] ; OFF state < 1 V) @ max 50 mA; external negative voltage not allowed (e.g. due to inductive loads)			
Alarms	Solenoid not connected/short circuit, cable break with current reference signal, over/under temperature, position control monitoring, valve spool transducer malfunctions, alarms history storage function			
Position transducers power supply	+24 VDC @ max 100 mA or +5 VDC @ max 100 mA are software selectable			
Pressure/Force transducers power supply	+24 VDC @ max 100 mA			
Format	Plastic box ; IP20 protection degree ; L 35 - H 7,5 mm DIN-rail mounting as per EN60715			
Operating temperature	-20 ÷ +50 °C (storage -25 ÷ +85 °C)			
Mass	Approx. 450 g			
Additional characteristics	8 leds for diagnostic; protection against reverse polarity of power supply			
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			
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: 0,5 mm² max 50 m for logic - 1,5 mm² max 50 m for power supply Note: for transducers wiring cable please consult the transducers datasheet			
Max conductor size (see 15)	2,5 mm²			

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

8 CONNECTIONS AND LEDS



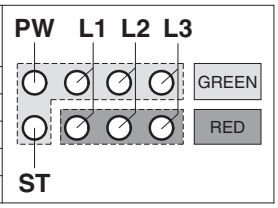
(1) D connector is available only for Z-BM-LEZ-**-01H

(2) To interface with Siemens 6ES7972-0BA12-0XA connector, it is mandatory to use also one of the following adapters to avoid interference with the USB connector: DG909MF1 - the connector will be oriented upwards; DG909MF3 - the connector will be oriented downwards

8.1 Diagnostic LEDs (L)

Eight 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			
PW	OFF = Power supply OFF		ON = Power supply ON				
ST	OFF = Fault present		ON = No fault				



8.2 Connectors - 4 pin

CONNECTOR	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
A	A1	**V+**	Power supply 24 VDC (see 10.1)	Input - power supply
	A2	**V0**	Power supply 0 VDC (see 10.1)	Gnd - power supply
	A3	**VL+**	Power supply 24 VDC for axis card logic and communication (see 10.2)	Input - power supply
	A4	**VL0**	Power supply 0 VDC for axis card logic and communication (see 10.2)	Gnd - power supply
B	B1	**P_INPUT+**	Position reference input signal: ±10 VDC / ±20 mA maximum range. default is ±10 VDC (see 10.3)	Input - analog signal **Software selectable**
	B2	**INPUT-**	Negative reference input signal for P_INPUT+ and F_INPUT+	Input - analog signal
	B3	**F_INPUT+**	Force reference input signal (SF, SL controls): ±10 VDC / ±20 mA maximum range; default is ±10 VDC (see 10.4)	Input - analog signal **Software selectable**
	B4	**EARTH**	Connect to system ground	
C	C1	**P_MONITOR**	Position monitor output signal: ±10 VDC / ±20 mA maximum range, referred to AGND; default is ±10 VDC (see 10.5)	Output - analog signal **Software selectable**
	C2	**ENABLE**	Enable (24 VDC) or disable (0 VDC) the axis card, referred to VL0 (see 10.7)	Input - on/off signal
	C3	**F_MONITOR**	Force (SF, SL controls) or valve spool position (SN control) monitor output signal: ±10 VDC / ±20 mA maximum range, referred to AGND; default is ±10 VDC (see 10.6)	Output - analog signal **Software selectable**
	C4	**FAULT**	Fault (0 VDC) or normal working (24 VDC), referred to VL0 (see 10.8)	Output - on/off signal
D (1)	D1	**LVDT_L**	Main stage valve LVDT position transducer signal (see 10.11)	Input - analog signal
	D2	**-15V**	Main stage valve LVDT position transducer power supply -15V	Output power supply
	D3	**+15V**	Main stage valve LVDT position transducer power supply +15V	Output power supply
	D4	**AGND**	Common gnd for transducer power supply and monitor outputs	Common gnd
E	E1	**LVDT_T**	Direct valve or pilot valve LVDT position transducer signal (see 10.11)	Input - analog signal
	E2	**-15V**	Direct valve or pilot valve LVDT position transducer power supply -15V	Output power supply
	E3	**+15V**	Direct valve or pilot valve LVDT position transducer power supply +15V	Output power supply
	E4	**AGND**	Common gnd for transducer power supply and monitor outputs	Common gnd
F	F1	**SOL_S1-**	Negative current to solenoid S1	Output - power PWM
	F2	**SOL_S1+**	Positive current to solenoid S1	Output - power PWM
	F3	**SOL_S2-**	Negative current to solenoid S2	Output - power PWM
	F4	**SOL_S2+**	Positive current to solenoid S2	Output - power PWM
G	G1	Digital position transducer SSI or Encoder is software selectable: - SSI connections see 8.3 - Encoder connections see 8.4		
	G2			
	G3			
	G4			
H	H1	Digital position transducer SSI or Encoder is software selectable: - SSI connections see 8.3 - Encoder connections see 8.4		
	H2			
	H3			
	H4			
I	I1	**VP**	Power supply: +24VDC , +5VDC or OFF (default OFF)	Output - power supply **Software selectable**
	I2	**P_TR1**	Analog position transducer input signal ±10 VDC / ±20 mA maximum range; default is ±10 VDC (see 10.9)	Input - analog signal **Software selectable**
	I3	**AGND**	Common gnd for transducer power supply and signals	Common gnd
	I4	**NC**	Do not connect	
J	J1	**VF +24V**	Power supply: +24VDC or OFF (default OFF)	Output - power supply **Software selectable**
	J2	**F_TR1**	1st signal pressure/force transducer: ±10 VDC / ±20 mA maximum range; default is ±10 VDC (see 10.10)	Input - analog signal **Software selectable**
	J3	**AGND**	Common gnd for transducer power supply and signals	Common gnd
	J4	**NC**	Do not connect	
K	K1	**VF +24V**	Power supply: +24VDC or OFF (default OFF)	Output - power supply **Software selectable**
	K2	**F_TR2**	2nd signal pressure transducer (only for SF): ±10 VDC / ±20 mA maximum range; default is ±10 VDC (see 10.10)	Input - analog signal **Software selectable**
	K3	**AGND**	Common gnd for transducer power supply and signals	Common gnd
	K4	**NC**	Do not connect	

(1) D connector is available only for Z-BM-LEZ-**-01H

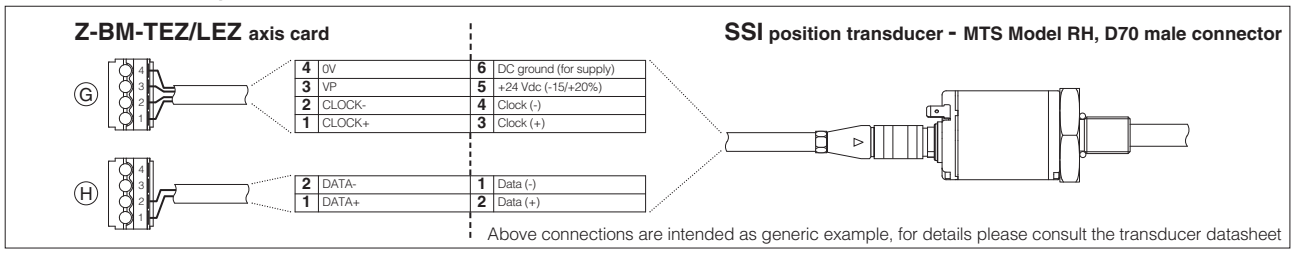
8.3 SSI connectors signals - 4 pin

G	G1	**CLOCK+**	Serial synchronous clock (+)	Output - on/off signal
	G2	**CLOCK-**	Serial synchronous clock (-)	Output - on/off signal
	G3	**VP**	Power supply: +24VDC , +5VDC or OFF (default OFF)	Output - power supply **Software selectable**
	G4	**0V**	Common gnd for transducer power and signals	Common gnd

H	H1	**DATA+**	Serial position data (+)	Input - on/off signal
	H2	**DATA-**	Serial position data (-)	Input - on/off signal
	H3	**NC**	Do not connect	
	H4	**NC**	Do not connect	

Note: for Balluff BTL7 with SSI interface only special code SA433 is supported

SSI connection - example

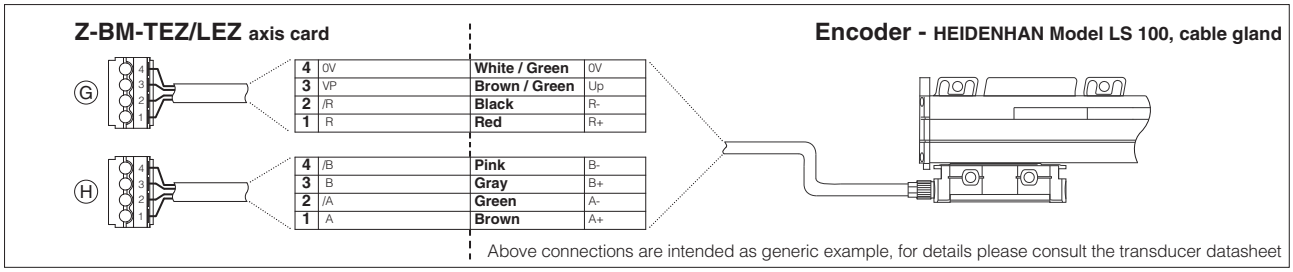


8.4 Encoder connectors signals - 4 pin

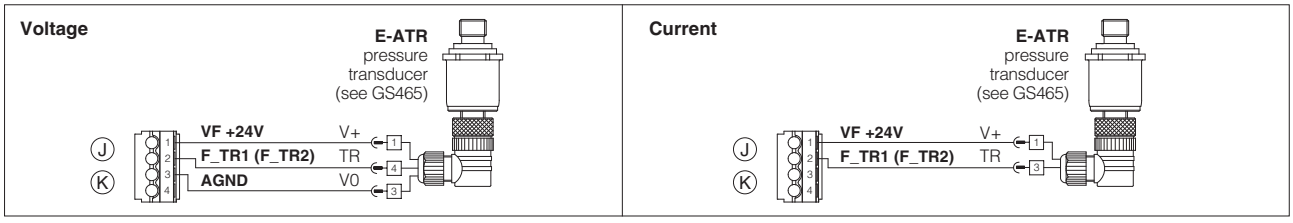
G	G1	**R**	Input channel R	Input - on/off signal
	G2	**/R**	Input channel /R	Input - on/off signal
	G3	**VP**	Power supply: +24VDC , +5VDC or OFF (default OFF)	Output - power supply **Software selectable**
	G4	**0V**	Common gnd for transducer power and signals	Common gnd

H	H1	**A**	Input channel A	Input - on/off signal
	H2	**/A**	Input channel /A	Input - on/off signal
	H3	**B**	Input channel B	Input - on/off signal
	H4	**/B**	Input channel /B	Input - on/off signal

Encoder connection - example



8.5 Pressure/force transducers connection - example



8.6 Communication connectors ③ - ④ - ⑤ - ⑥ - ⑦

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

④ **BC fieldbus execution, connector - DB9 - 9 pin**		
PIN	**SIGNAL**	**TECHNICAL SPECIFICATION** (1)
2	**CAN_L**	Bus line (low)
3	**CAN_GND**	Signal zero data line
5	**CAN_SHLD**	Shield
7	**CAN_H**	Bus line (high)

⑤ **BP fieldbus execution, connector - DB9 - 9 pin**		
PIN	**SIGNAL**	**TECHNICAL SPECIFICATION** (1)
1	**SHIELD**	
3	**LINE-B**	Bus line (low)
5	**DGND**	Data line and termination signal zero
6	**+5V**	Termination supply signal
8	**LINE-A**	Bus line (high)

⑥ ⑦ **EH, EW, EI, EP fieldbus execution, connector - RJ45 - 8 pin**		
PIN	**SIGNAL**	**TECHNICAL SPECIFICATION** (1)
1	**TX+**	Transmitter - white/orange
2	**TX-**	Transmitter - orange
3	**RX+**	Receiver - white/green
6	**RX-**	Receiver - green

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

9 SET CODE

The basic calibration of axis card is factory preset, according to the proportional valve to be coupled. These pre-calibrations are identified by the set code at the end of axis card model code (see section 1). For correct set code selection, please include in the axis card order also the complete code of the coupled proportional valve. For further information about set code, please contact Atos technical office.

10 POWER SUPPLY AND SIGNALS SPECIFICATIONS

Atos digital axis card 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.
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).

10.1 Power supply (V+ and V0)

The power supply (pin A1 and A2) must be appropriately stabilized or rectified and filtered: apply at least a 10000 μF/40 V capacitance to single phase rectifiers or a 4700 μF/40 V capacitance to three phase rectifiers.

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

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

The power supply (pin A3 and A4) 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, allow to remove solenoid power supply from pin A1 and A2 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.

10.3 Position reference input signal (P_INPUT+)

Functionality of P_INPUT+ signal (pin B1), depends on axis card reference mode, see section 4 :
external analog reference (see 4.1): input is used as reference for control in closed loop the actuator position.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA; default is ±10 VDC

external fieldbus reference (see 4.1) *or automatic cycle* (see 4.2)*:* analog reference input signal can be used as on-off commands with input range 0 ÷ 24VDC.

10.4 Force reference input signal (F_INPUT+)

Functionality of F_INPUT+ signal (pin B3), depends on selected axis card reference mode and alternated control options, see section 5 :
SL, SF controls and external analog reference selected : input is used as reference for the axis card pressure/force closed loop.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA; default is ±10 VDC

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

10.5 Position monitor output signal (P_MONITOR)

The axis card generates an analog output signal (pin C1) 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).
The output range and polarity are software selectable within the maximum range ±10 VDC or ±20 mA; default is ±10 VDC

10.6 Force monitor output signal (F_MONITOR)

The axis card generates an analog output signal (pin C3) 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 pressure/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 VDC or ±20 mA; default is ±10 VDC

10.7 Enable Input Signal (ENABLE)

To enable the axis card, a 24VDC voltage has to be applied on pin C2
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)

10.8 Fault output signal (FAULT)

Fault output signal (pin C4) indicates fault conditions of the axis card (solenoid short circuits/not connected, reference or transducer signalcable broken, maximum error exceeded, etc.). Fault presence corresponds to 0 VDC, normal working corresponds to 24 VDC
Fault status is not affected by the status of the Enable input signal.
Fault output signal can be used as digital output by software selection.

10.9 Position transducer input signals

A position transducer must be always directly connected to the axis card. Position digital input signals are factory preset to binary SSI, they can be reconfigured via software selecting between binary/gray SSI, Encoder or generic transducer with analog interface.
Input signals can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA; default is ±10 VDC
Refer to position transducer characteristics to select the transducer type according to specific application requirements, see section 11 .

10.10 Remote pressure/force transducer input signals (F_TR1 and F_TR2) - SF, SL controls

Analog remote pressure transducers or load cell can be directly connected to the axis card.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA; default is ±10 VDC
Refer to pressure/force transducer characteristics to select the transducer type according to specific application requirements, see section 11 .

10.11 Main stage and direct or pilot position transducer input signals (LVDT_L and LVDT_T)

Main stage (LVDT_L pin D1) and direct or pilot (LVDT_T pin E1) position transducer integrated to the valve have to be directly connected to the axis card using ±15 VDC supply output available at pin D2, D3 and pin E2, E3.
Note: transducer input signals working range is ±10 VDC for standard or 4 ÷ 20 mA for /C option and **cannot** be reconfigured via software (input signals setting depends to the axis card set code).

10.12 Possible combined options: /AC

11 ACTUATOR'S TRANSDUCER CHARACTERISTICS

11.1 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: analog signal (analog), SSI or Encoder (digital).
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.

11.2 Pressure/force transducers

The accuracy of the pressure/force control is strongly dependent to the selected pressure/force transducer (see section 5).
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.

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

	Position			Pressure/Force
Input type	Analog	SSI **(3)**	Incremental Encoder	Analog
Power supply **(1)**	+24 VDC	+5 VDC or +24 VDC	+5 VDC or +24 VDC	+24 VDC
Axis card interface	0 ÷ 10V or 4 ÷ 20 mA	Serial SSI binary/gray	TTL 5Vpp - 150 KHz	±10 VDC or 4 ÷ 20 mA
Max speed	1 m/s	2 m/s	2 m/s	-
Max resolution	< 0.2 % FS	1 µm	1 µm (@ 0.15 m/s)	< 0.4 % FS
Linearity error **(2)**	< ±0.03% FS	< ± 0.01 % FS	< ± 0.001 % FS	< ±0.25% FS
Repeatability **(2)**	< ± 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

12 VALVE SETTINGS AND PROGRAMMING TOOLS

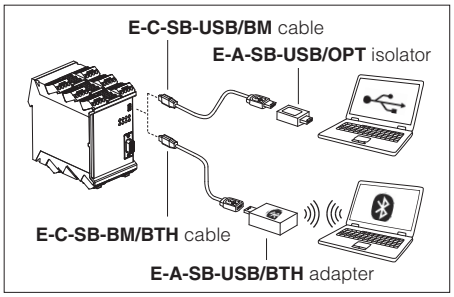
Valve's functional parameters and configurations, can be easily set and optimized using Atos Z-SW programming software connected via USB port to the digital axis card (see table **FS900**).
For fieldbus versions, the software permits valve's parameterization through USB port also if the axis card is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

The software is available in different versions according to the axis card options (see table **GS500**):

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

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

USB or Bluetooth connection



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

DVD programming software, to be ordered separately:

Z-SW-FULL DVD first supply = software has to be activated via web registration at ; 1 year service included
Upon web registration user receive via email the Activation Code (software license) and login data to access Atos Download Area

Z-SW-FULL-N DVD next supplies = only for supplies after the first; service not included, web registration not allowed
Software has to be activated with Activation Code received upon first supply web registration

Atos Download Area: direct access to latest releases of Z-SW software, manuals, USB drivers and fieldbus configuration files at **USB**

Adapters, Cables and Terminators, can be ordered separately

13 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-BM-LEZ - user manual for **Z-BM-LEZ** and **Z-BM-TEZ**

13.1 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)

13.2 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

13.3 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 13.4)

13.4 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.)

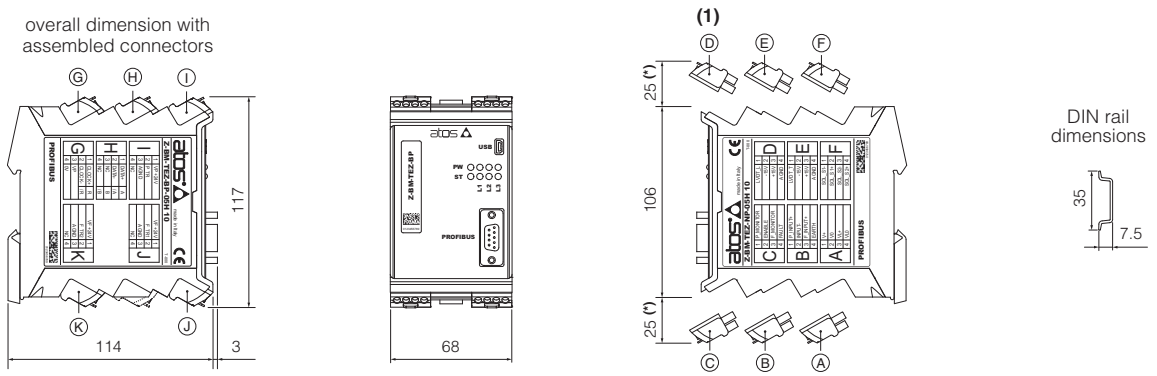
13.5 Valve characteristics compensation

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

13.6 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 4.2).

14 OVERALL DIMENSIONS [mm]



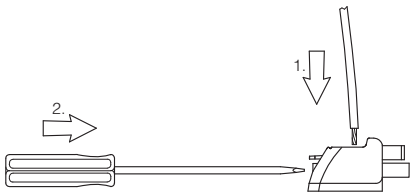
A,B,C,D,E,F,G,H,I,J,K connectors included

(*) Space to remove the connectors

(1) D connector is available only for Z-BM-LEZ-**-01H

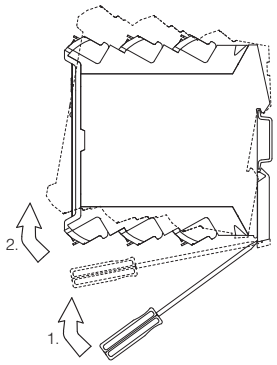
15 INSTALLATION

To wire cables in the connectors:
1. insert cable into the termination
2. turn screw with a screwdriver



Note: max conductor size: 2,5 mm²
tightening torque: 0,4 ÷ 0,6 Nm

To unlock the axis card from the DIN rail:
1. pull down the locking slide with a screwdriver
2. rotate up the axis card



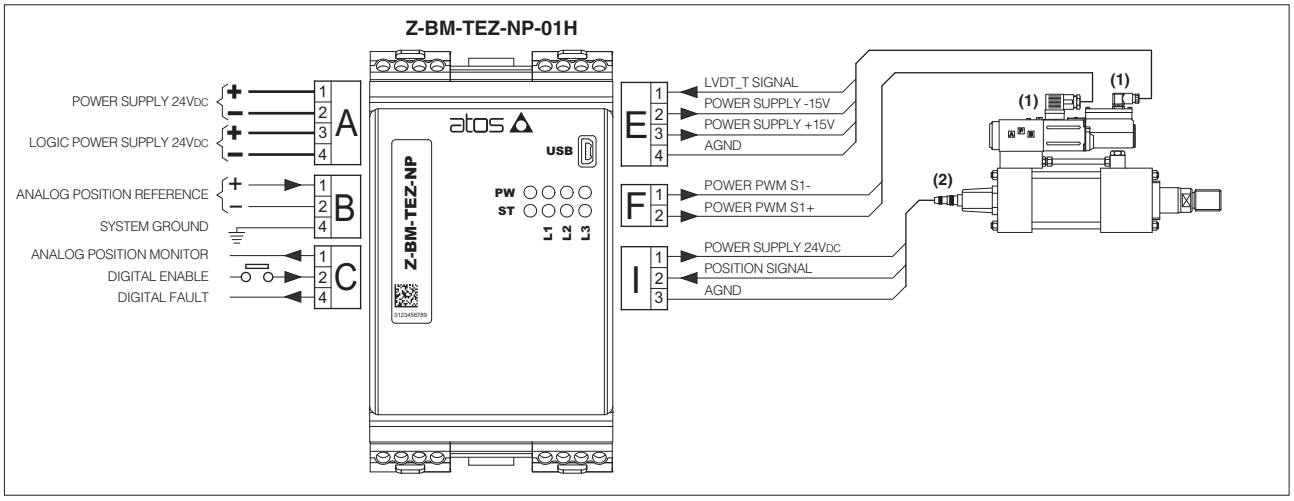
To extract the connectors:
1. push lever
2. pull connector

To insert the connectors:
1. push the connector in its slot

Note: all connectors are supplied with a mechanical coding. This feature ensures a unique insertion of each connector in the own slot.
(eg. connector A can not be inserted into connector slot of B,C,D,E,F,G,H,I,J,K)

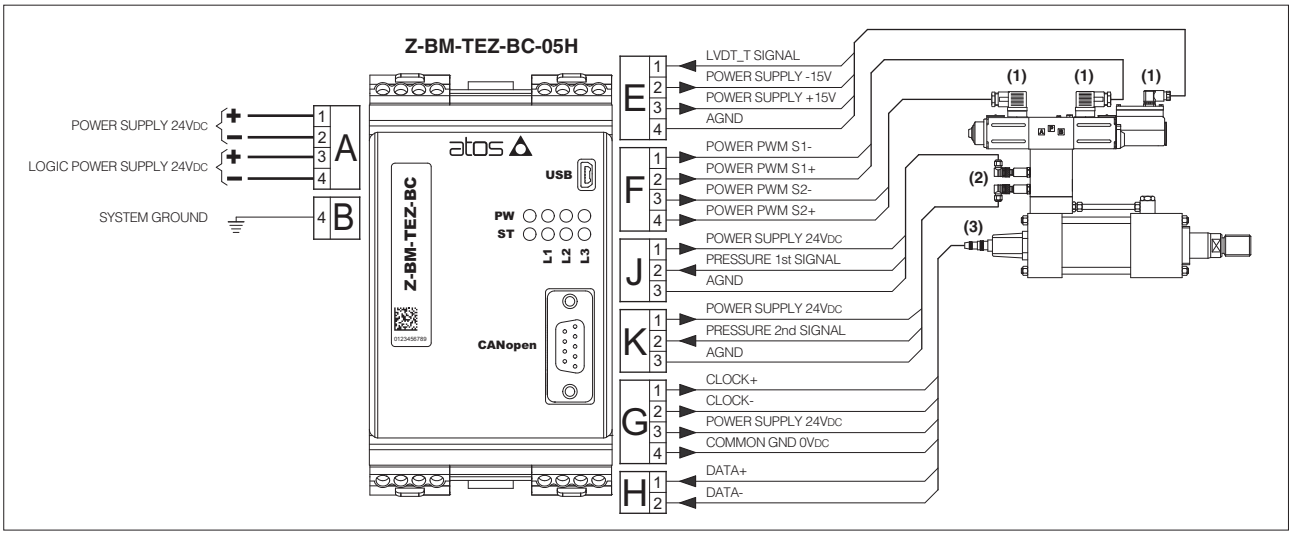
16 WIRING EXAMPLES

16.1 Position control - analog reference - analog position transducer



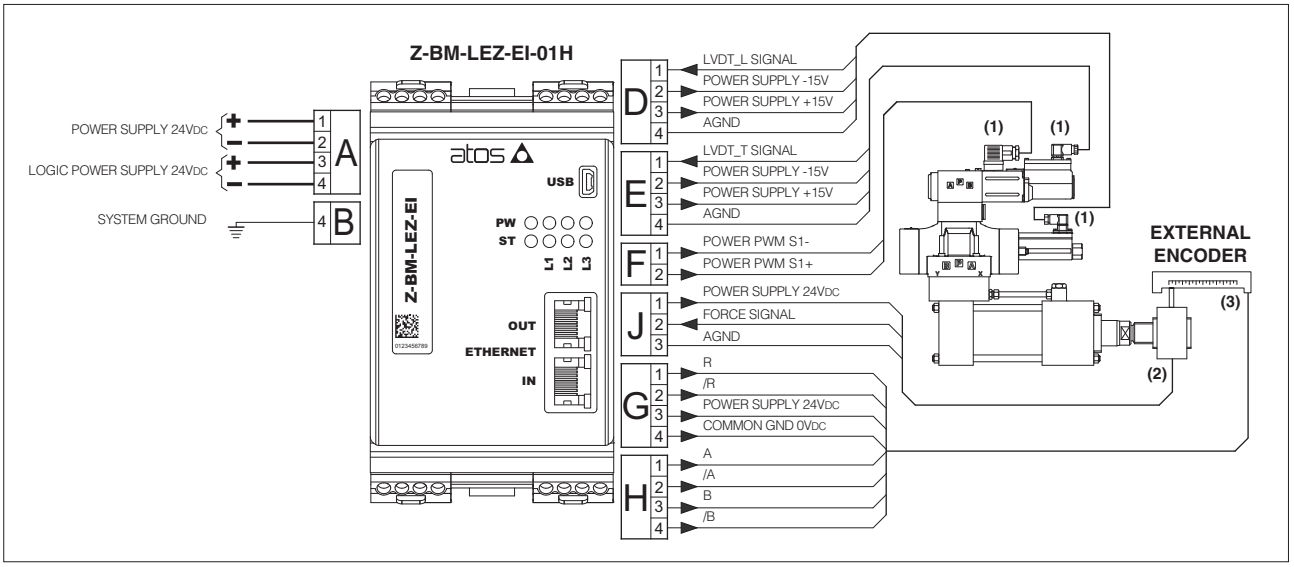
(1) For valve electrical connections please refer to the specific technical table
(2) The analog position transducer connections are intended as generic example, for details please consult the transducer datasheet

16.2 Alternated position/force control - CANopen reference - SSI position transducer - 2 analog pressure transducers



(1) For valve electrical connections please refer to the specific technical table
(2) Pressure transducers connections are shown with voltage signal output; for connections with current signal output see 8.5
(3) The SSI position transducer connections are intended as generic example, for details please consult the transducer datasheet

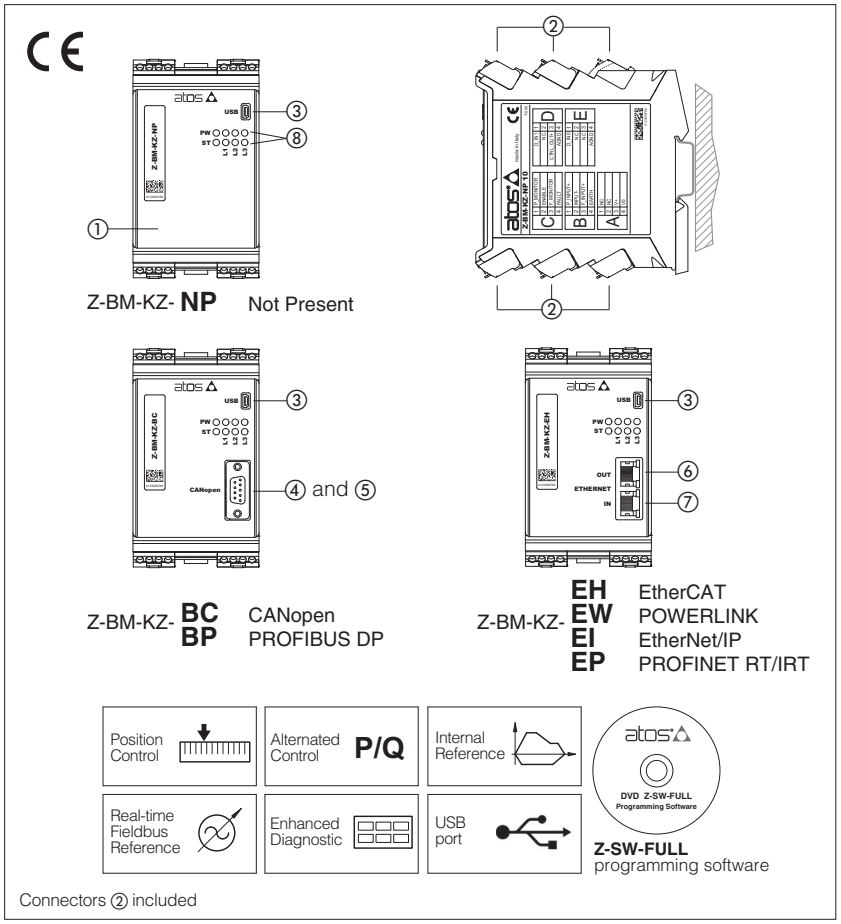
16.3 Alternated position/force control - EtherNet/IP reference - Encoder position transducer - analog load cell



(1) For valve electrical connections please refer to the specific technical table
(2) Load cell connections is shown with voltage signal output; please consult the load cell datasheet for details about connections
(3) The Encoder position transducer connections are intended as generic example, for details please consult the transducer datasheet

Digital Z-BM-KZ axis cards

DIN-rail format, for position and force controls



Z-BM-KZ

Digital axis cards ① perform the position closed loop of linear or rotative hydraulic axes.

The axis card generates a reference signal to the proportional valve which regulates the hydraulic flow to the actuator.

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

The axis card can be operated via an external reference signal or automatic cycle, see section 4.

A force alternated control may be set by software additionally to the position control: a pressure/force transducer has to be assembled into the actuator and connected to the axis card; a second pressure/force reference signal is required.

Atos PC software allows to customize the axis card configuration to the specific application requirements.

Electrical Features:

- 10 fast plug-in connectors ②
- Mini USB port ③ always present
- DB9 fieldbus communication connector ④ for CANopen and ⑤ PROFIBUS DP
- RJ45 ethernet communication connectors ⑥ output and ⑦ input for EtherCAT, POWERLINK, EtherNet/IP, PROFINET
- 8 leds for diagnostics ⑧ (see 8.1)
- Electrical protection against reverse polarity of power supply
- Operating temperature range: -20 ÷ +50 °C
- Plastic box with IP20 protection degree and standard DIN-rail mounting
- CE mark according to EMC directive

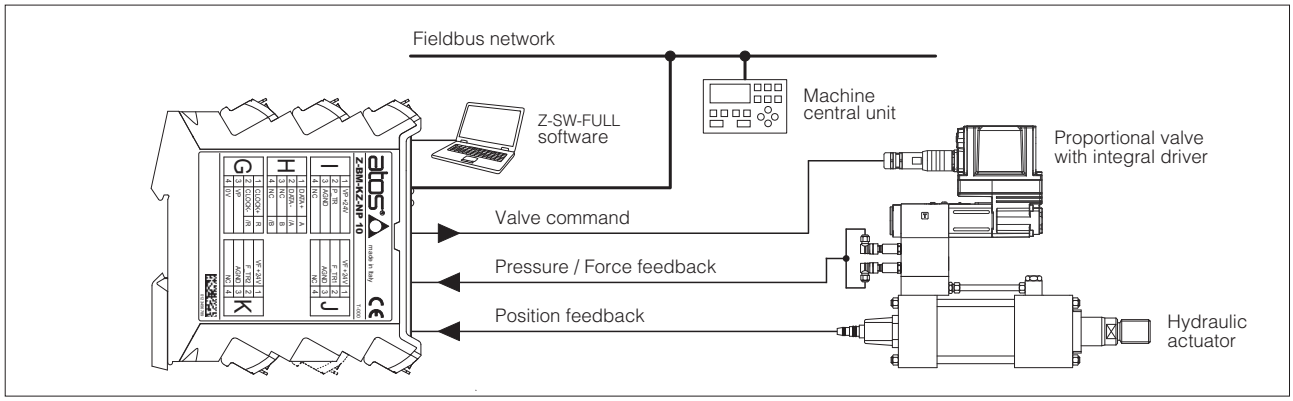
Software Features:

- Intuitive graphic interface
- Internal generation of motion cycle
- Setting of axis's dynamic response (PID) to optimize the application performances
- Setting of valve's functional parameters: bias, scale, ramps, dither
- Linearization function for hydraulic regulation
- Complete diagnostics of axis status
- Internal oscilloscope function
- In field firmware update through USB port

1 MODEL CODE

Z-BM	-	KZ	-	NP	*
Off-board electronic axis card in DIN rail format		Alternated position / force (or position / pressure) control module		**Fieldbus interface**, USB port always present: **NP** = Not Present **BC** = CANopen **BP** = PROFIBUS DP **EH** = EtherCAT **EW** = POWERLINK **EI** = EtherNet/IP **EP** = PROFINET RT/IRT	Series number

2 BLOCK DIAGRAM EXAMPLE



Note: block diagram example for alternated position/force control, with fieldbus interface

3 VALVES RANGE

Valves	Directional					
Industrial Tech table	**DHZO-TEB, DKZOR-TEB** FS168	**DHZO-TES, DKZOR-TES** FS168	**DLHZO-TEB, DLKZOR-TEB** FS180	**DLHZO-TES, DLKZOR-TES** FS180	**DPZO-LEB** FS178	**DPZO-LES** FS178
Ex-proof Tech table	-	**DHZA-TES, DKZA-TES** FX135	-	**DLHZA-TES, DLKZA-TES** FX150	-	**DPZA-LES** FX235

4 POSITION CONTROL

4.1 External reference signal

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

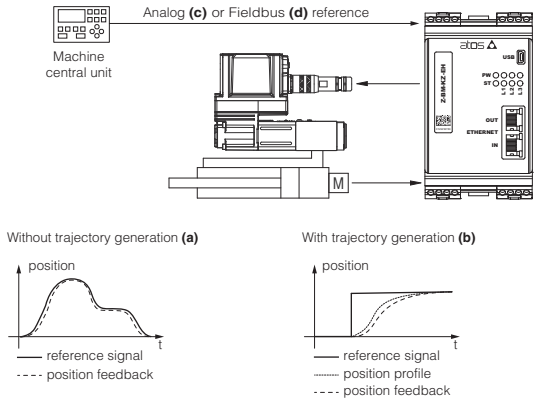
Position profile can be managed in two ways (software selectable):

- 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.

External reference signal

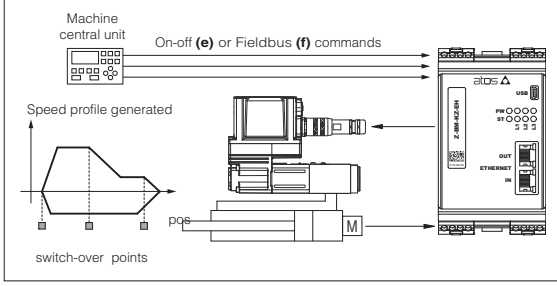


4.2 Automatic cycle

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.

Automatic cycle



5 ALTERNATED POSITION / FORCE CONTROL

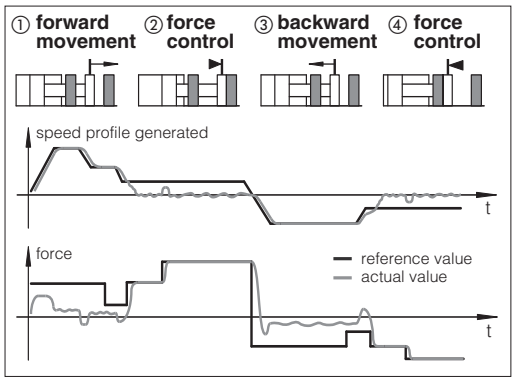
The alternated force closed loop control can be added to the actuator standard position control, requiring one or two remote transducers (pressure or force) that have to be installed on the actuator, see below functional schemes.

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.

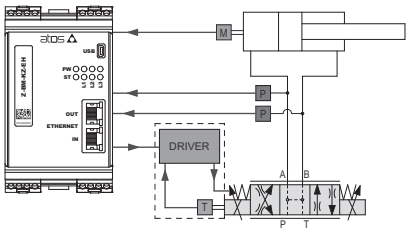
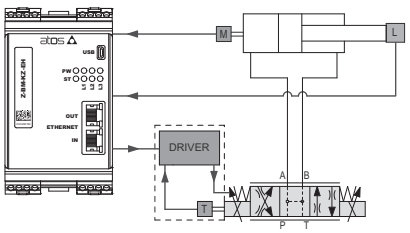
The dynamics of the switching between the two controls can be regulated thanks to specific software setting, in order to avoid instability and vibrations.

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.



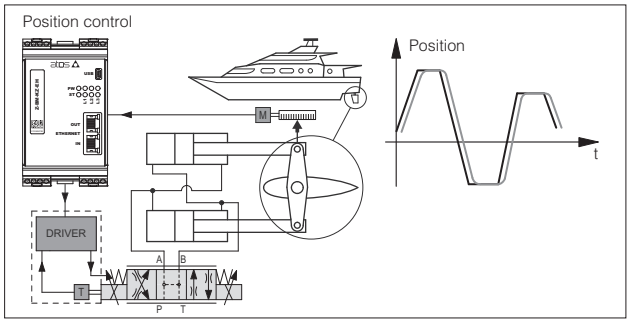
Alternated control configurations - software selectable

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's spool transducer | M actuator's 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 both hydraulic line.
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 hydraulic actuator.
General Notes:
- servoproportional type DLHZO, DLKZOR, DPZO-L are strongly recommended for high accuracy applications - see tech tables **FS180**, **FS178**
- auxiliary check valves are recommended in case of specific hydraulic configuration requirements in absence of power supply or fault - see tech table **EY105**
- for additional information about alternated P/Q controls configuration please refer to tech table **FS500**
- Atos technical service is available for additional evaluations related to specific applications usage

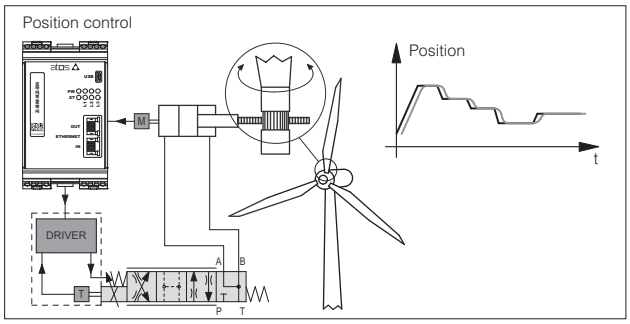
6 APPLICATION EXAMPLES



Hydraulic steering wheel in marine applications

Rudder axis card on motor yachts and sail boats requires smooth control for precise and reliable operations.

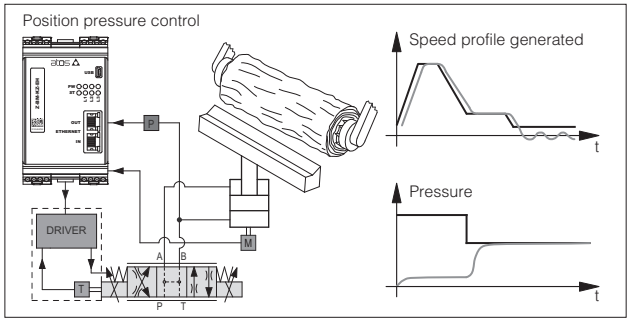
Z-BM-KZ axis cards perform the rudder position control system, ensuring accurate and repetitive regulations for a comfortable ride, thanks to:
- analog position reference mode for real time controls
- analog position transducer for simple and compact solution
- position PID control parameters to optimize the system response
- complete diagnostic information for advanced system monitoring



Wind turbines

The pitch control of the rotor blades is required to maximize the energy production. Accurate positioning, decentralized intelligence as well as long service life and reliability are required.

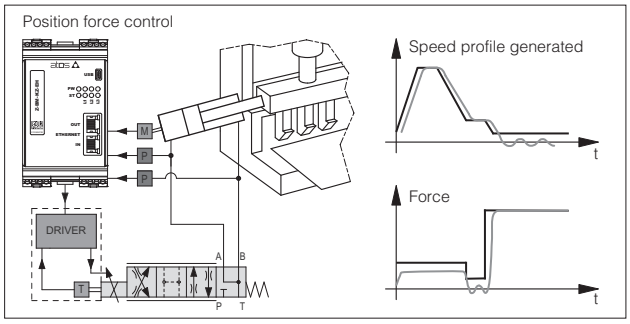
Z-BM-KZ axis cards perform high quality regulation of the blade pitch simplifying the system architecture, thanks to:
- SSI digital position transducer for high precision control
- complete remote system management with fieldbus interface
- position PID selection to adapt the position control to the different wind conditions



Wood machinery

Hydraulic wood machines require configurable and repetitive motion profiles, accurate position controls, and digital signals for synchronization purpose.

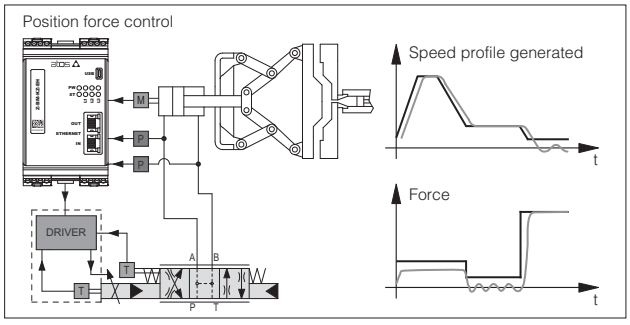
Z-BM-KZ axis cards allow remote control, thanks to:
- internal reference generation with maximum speed and acceleration settings
- analog position transducer for simple and reliable solution
- pressure transducer for alternated pressure control
- fieldbus connection for remote parameterization, commands, and axis card state indication



Bending Machines

Machine tools for cold-forming flat sheets require complete, automatic, programmable and flexible machine control to produce sheet metal panels from punched blank.

Z-BM-KZ axis cards combine high level position regulation with accurate force control to provide in a single device a complete and dedicated solution, thanks to:
- internal reference generation to simplify the machine control cycle
- digital position sensor for high resolution measurement system
- two pressure transducers for alternated force control
- fieldbus interface for easy machine control integration
- auxiliary digital outputs for system status indication (target reached, force control active)



Die-casting machinery

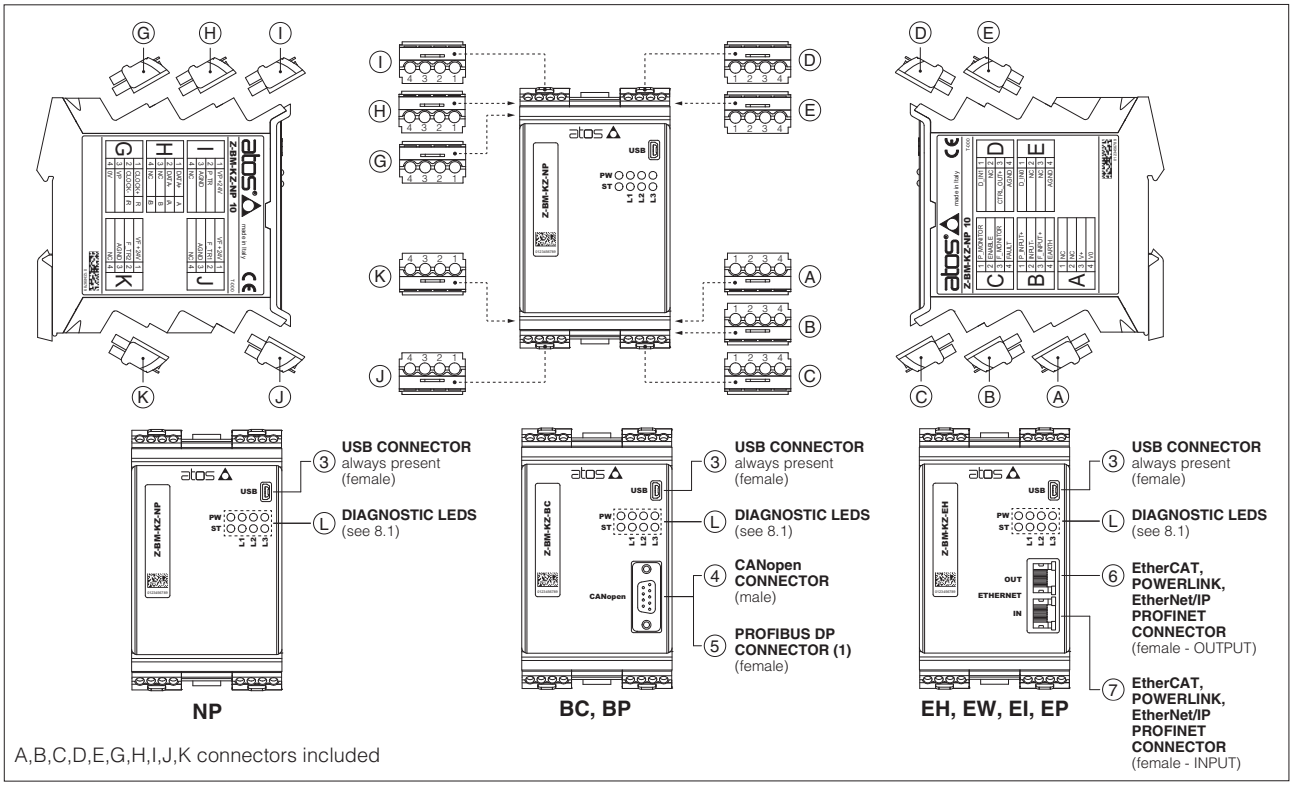
Clamp movements in die-casting phases involve fast/slow motion cycle with accurate and repetitive alternated position/force controls for the mould safety functions.

Z-BM-KZ axis cards, with alternated position/force control, simplify the hydraulic + electronic system architecture, thanks to:
- internal reference generation for repetitive working cycles
- SSI digital position transducer for accurate axis control
- two pressure transducers for alternated force control
- auxiliary digital inputs/output to synchronize the machine functions
- fieldbus connection for machine remote control and advanced diagnostics

7 MAIN CHARACTERISTICS

Power supply	(see 9.1)	Nominal : +24 VDC Rectified and filtered : VRMS = 20 ÷ 32 VMAX (ripple max 10 % VPP)			
Max power consumption		10 W			
Analog input signals	(see 9.2, 9.3)	Voltage: range ±10 VDC (24 VMAX tollerant) Input impedance: Ri > 50 kΩ Current: range ±20 mA Input impedance: Ri = 500 Ω			
Monitor outputs Control output	(see 9.4, 9.5) (see 9.10)	Output range: voltage ±10 VDC @ max 5 mA current ±20 mA @ max 500 Ω load resistance			
Enable input Digital inputs	(see 9.6) (see 9.11)	Range: 0 ÷ 5 VDC (OFF state), 9 ÷ 24 VDC (ON state), 5 ÷ 9 VDC (not accepted); Input impedance: Ri > 10 kΩ			
Fault output	(see 9.7)	Output range: 0 ÷ 24 VDC (ON state > [power supply - 2 V] ; OFF state < 1 V) @ max 50 mA; external negative voltage not allowed (e.g. due to inductive loads)			
Alarms		Cable break with current reference signal, over/under temperature, position control monitoring			
Position transducers power supply		+24 VDC @ max 100 mA or +5 VDC@ max 100 mA are software selectable			
Pressure/Force transducers power supply		+24 VDC @ max 100 mA			
Format		Plastic box ; IP20 protection degree ; L 35 - H 7,5 mm DIN-rail mounting as per EN60715			
Operating temperature		-20 ÷ +50 °C (storage -25 ÷ +85 °C)			
Mass		Approx. 450 g			
Additional characteristics		8 leds for diagnostic; protection against reverse polarity of power supply			
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			
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: 0,5 mm² max 50 m for logic - 1,5 mm² max 50 m for power supply Note: for transducers wiring cable please consult the transducers datasheet			
Max conductor size	(see 14)	2,5 mm²			

8 CONNECTIONS AND LEDS



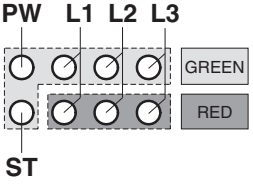
A,B,C,D,E,G,H,I,J,K connectors included

(1) To interface with Siemens 6ES7972-0BA12-0XA connector, it is mandatory to use also one of the following adapters to avoid interference with the USB connector: DG909MF1 - the connector will be oriented upwards; DG909MF3 - the connector will be oriented downwards

8.1 Diagnostic LEDs (L)

Eight 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	ALARM STATUS			LINK/ACT			
PW	OFF = Power supply OFF		ON = Power supply ON				
ST	OFF = Fault present		ON = No fault				



8.2 Connectors - 4 pin

CONNECTOR	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
A	A1	**NC**	Do not connect	
	A2	**NC**	Do not connect	
	A3	**V+**	Power supply 24 VDC (see 9.1)	Input - power supply
	A4	**V0**	Power supply 0 VDC (see 9.1)	Gnd - power supply
B	B1	**P_INPUT+**	Position reference input signal: ±10 VDC / ±20 mA maximum range; default is ±10 VDC (see 9.2)	Input - analog signal **Software selectable**
	B2	**INPUT-**	Negative reference input signal for P_INPUT+ and F_INPUT+	Input - analog signal
	B3	**F_INPUT+**	Force reference input signal (SF, SL controls): ±10 VDC / ±20 mA maximum range; default is ±10 VDC (see 9.3)	Input - analog signal **Software selectable**
	B4	**EARTH**	Connect to system ground	
C	C1	**P_MONITOR**	Position monitor output signal: ±10 VDC / ±20 mA maximum range, referred to AGND; default is ±10 VDC (see 9.4)	Output - analog signal **Software selectable**
	C2	**ENABLE**	Enable (24 VDC) or disable (0 VDC) the axis card, referred to V0 (see 9.6)	Input - on/off signal
	C3	**F_MONITOR**	Force (SF, SL controls) or valve spool position (SN control) monitor output signal: ±10 VDC / ±20 mA maximum range, referred to AGND; default is ±10 VDC (see 9.5)	Output - analog signal **Software selectable**
		NC	For EW, EI, EP executions the F_MONITOR is not available: do not connect	
	C4	**FAULT**	Fault (0 VDC) or normal working (24 VDC), referred to V0 (see 9.7)	Output - on/off signal
D	D1	**D_IN1**	Digital input 0 ÷ 24VDC, referred to AGND (see 9.11)	Input - on/off signal
	D2	**NC**	Do not connect	
	D3	**CTRL_OUT+**	Control output signal for external valve driver, referred to AGND (see 9.10)	Output - analog signal **Software selectable**
	D4	**AGND**	Common gnd for digital input and control output	Common gnd
E	E1	**D_IN0**	Digital input 0 ÷ 24VDC, referred to AGND (see 9.11)	Input - on/off signal
	E2	**NC**	Do not connect	
	E3	**NC**	Do not connect	
	E4	**AGND**	Common gnd for digital input and monitor outputs	Common gnd
G	G1	Digital position transducer SSI or Encoder is software selectable: - SSI connections see 8.3 - Encoder connections see 8.4		
	G2			
	G3			
	G4			
H	H1	Digital position transducer SSI or Encoder is software selectable: - SSI connections see 8.3 - Encoder connections see 8.4		
	H2			
	H3			
	H4			
I	I1	**VP**	Power supply: +24VDC , +5VDC or OFF (default OFF)	Output - power supply **Software selectable**
	I2	**P_TR1**	Analog position transducer input signal ±10 VDC / ±20 mA maximum range; default is ±10 VDC (see 9.8)	Input - analog signal **Software selectable**
	I3	**AGND**	Common gnd for transducer power supply and signals	Common gnd
	I4	**NC**	Do not connect	
J	J1	**VF +24V**	Power supply: +24VDC or OFF (default OFF)	Output - power supply **Software selectable**
	J2	**F_TR1**	1st signal pressure/force transducer: ±10 VDC / ±20 mA maximum range; default is ±10 VDC (see 9.9)	Input - analog signal **Software selectable**
	J3	**AGND**	Common gnd for transducer power supply and signals	Common gnd
	J4	**NC**	Do not connect	
K	K1	**VF +24V**	Power supply: +24VDC or OFF (default OFF)	Output - power supply **Software selectable**
	K2	**F_TR2**	2nd signal pressure transducer (only for SF): ±10 VDC / ±20 mA maximum range; default is ±10 VDC (see 9.9)	Input - analog signal **Software selectable**
	K3	**AGND**	Common gnd for transducer power supply and signals	Common gnd
	K4	**NC**	Do not connect	

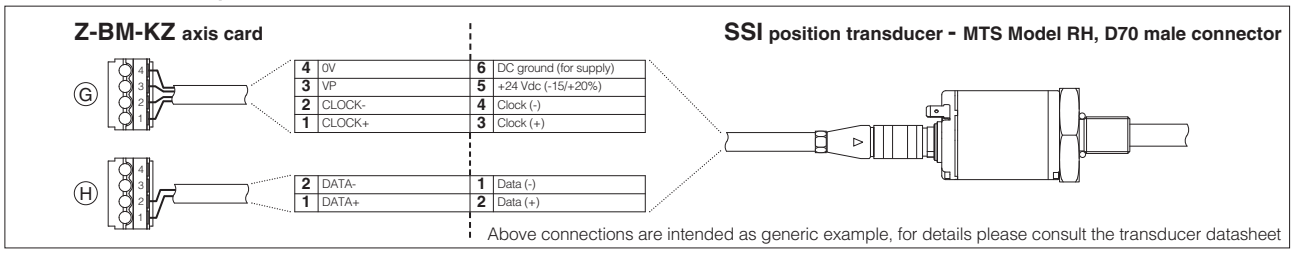
8.3 SSI connectors signals - 4 pin

G	G1	**CLOCK+**	Serial synchronous clock (+)	Output - on/off signal
	G2	**CLOCK-**	Serial synchronous clock (-)	Output - on/off signal
	G3	**VP**	Power supply: +24VDC , +5VDC or OFF (default OFF)	Output - power supply **Software selectable**
	G4	**0V**	Common gnd for transducer power supply and signals	Common gnd

H	H1	**DATA+**	Serial position data (+)	Input - on/off signal
	H2	**DATA-**	Serial position data (-)	Input - on/off signal
	H3	**NC**	Do not connect	
	H4	**NC**	Do not connect	

Note: for Balluff BTL7 with SSI interface only special code SA433 is supported

SSI connection - example

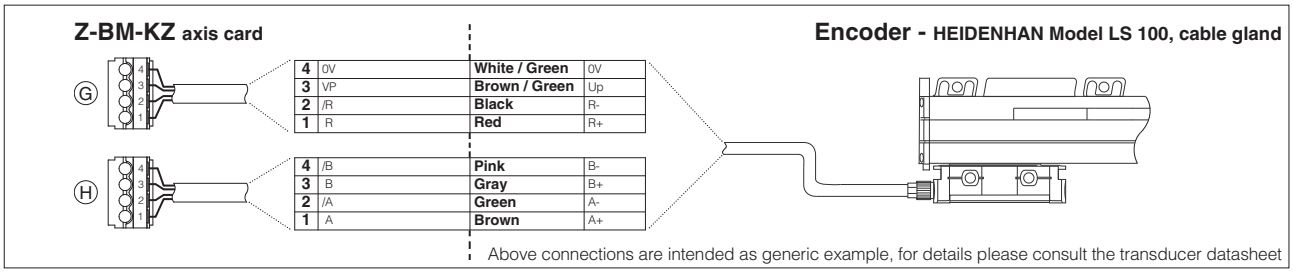


8.4 Encoder connectors signals - 4 pin

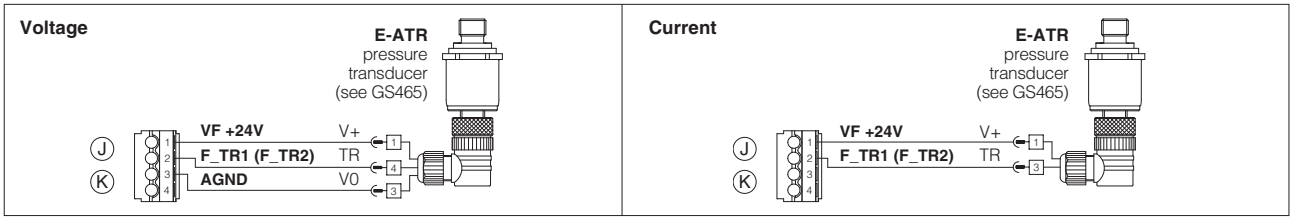
G	G1	**R**	Input channel R	Input - on/off signal
	G2	**/R**	Input channel /R	Input - on/off signal
	G3	**VP**	Power supply: +24VDC , +5VDC or OFF (default OFF)	Output - power supply **Software selectable**
	G4	**0V**	Common gnd for transducer power and signals	Common gnd

H	H1	**A**	Input channel A	Input - on/off signal
	H2	**/A**	Input channel /A	Input - on/off signal
	H3	**B**	Input channel B	Input - on/off signal
	H4	**/B**	Input channel /B	Input - on/off signal

Encoder connection - example



8.5 Pressure/force transducers connection - example



8.6 Communication connectors ③ - ④ - ⑤ - ⑥ - ⑦

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

④ **BC fieldbus execution, connector - DB9 - 9 pin**		
PIN	**SIGNAL**	**TECHNICAL SPECIFICATION** (1)
2	**CAN_L**	Bus line (low)
3	**CAN_GND**	Signal zero data line
5	**CAN_SHLD**	Shield
7	**CAN_H**	Bus line (high)

⑤ **BP fieldbus execution, connector - DB9 - 9 pin**		
PIN	**SIGNAL**	**TECHNICAL SPECIFICATION** (1)
1	**SHIELD**	
3	**LINE-B**	Bus line (low)
5	**DGND**	Data line and termination signal zero
6	**+5V**	Termination supply signal
8	**LINE-A**	Bus line (high)

⑥ ⑦ **EH, EW, EI, EP fieldbus execution, connector - RJ45 - 8 pin**		
PIN	**SIGNAL**	**TECHNICAL SPECIFICATION** (1)
1	**TX+**	Transmitter - white/orange
2	**RX+**	Receiver - white/green
3	**TX-**	Transmitter - orange
6	**RX-**	Receiver - green

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

9 SIGNALS SPECIFICATIONS

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

9.1 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.

⚠ A safety fuse is required in series to each power supply: 500 mA fast fuse.

9.2 Position reference input signal (P_INPUT+)

Functionality of P_INPUT+ signal (pin B1), depends on axis card reference mode, see section 4 :
external analog reference (see 4.1): input is used as reference for control in closed loop the actuator position.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA; default is ±10 VDC

external fieldbus reference (see 4.1) *or automatic cycle* (see 4.2)*:* analog reference input signal can be used as on-off commands with input range 0 ÷ 24 VDC.

9.3 Force reference input signal (F_INPUT+)

Functionality of F_INPUT+ signal (pin B3), depends on selected axis card reference mode and alternated control options, see section 5 :
SL, SF controls and external analog reference selected : input is used as reference for the axis card pressure/force closed loop.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA; default is ±10 VDC

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

9.4 Position monitor output signal (P_MONITOR)

The axis card generates an analog output signal (pin C1) 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).
The output range and polarity are software selectable within the maximum range ±10 VDC or ±20 mA; default is ±10 VDC

9.5 Force monitor output signal (F_MONITOR)

The axis card generates an analog output signal (pin C3) 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 pressure/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 VDC or ±20 mA; default is ±10 VDC

9.6 Enable Input Signal (ENABLE)

To enable the axis card, a 24 VDC voltage has to be applied on pin C2.
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)

9.7 Fault output signal (FAULT)

Fault output signal (pin C4) 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 status of the Enable input signal.
Fault output signal can be used as digital output by software selection.

9.8 Position transducer input signals

A position transducer must be always directly connected to the axis card. Position digital input signals are factory preset to binary SSI, they can be reconfigured via software selecting between binary/gray SSI, Encoder or generic transducer with analog interface.
Input signals can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA; default is ±10 VDC
Refer to position transducer characteristics to select the transducer type according to specific application requirements, see section 10 .

9.9 Remote pressure/force transducer input signals (F_TR1 and F_TR2) -SF, SL controls

Analog remote pressure transducers or load cell can be directly connected to the axis card.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA; default is ±10 VDC
Refer to pressure/force transducer characteristics to select the transducer type according to specific application requirements, see section 10 .

9.10 Control output signal (CTRL_OUT+)

The error signal processed by the control algorithms generates the control output signal (pin D3) for the external driver of the proportional valve which operates the hydraulic flow to the actuator.
The output range and polarity are software selectable within ±10 VDC (for voltage) or ± 20 mA (for current) maximum range referred to the analog ground AGND on pin D4; default setting is ±10 VDC

9.11 Digital input signals (D_IN0 and D_IN1)

Two on-off input signals are available on the pin E1 and D1. For each input by the Z-SW software, it is possible to set the polarity and to match a proper condition within the following:
- pressure/force PID selection (default)
- start/stop/switch-over command in case of internal reference generation (see 4.2)
- specific operative command for hydraulic axis mode (referencing mode, jog mode, automatic mode)
- jog command
- disable force alternated control

	PID SET SELECTION			
PIN	SET 1	SET 2	SET 3	SET 4
E1	0	24 VDC	0	24 VDC
D1	0	0	24 VDC	24 VDC

10 ACTUATOR'S TRANSDUCER CHARACTERISTICS

10.1 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 card, depending to the system requirements: analog signal (analog), SSI or Encoder (digital).
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.

10.2 Pressure/force transducers

The accuracy of the pressure/force control is strongly dependent to the selected pressure/force transducer (see section 5).
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.

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

	Position			Pressure/Force
Input type	Analog	SSI **(3)**	Incremental Encoder	Analog
Power supply **(1)**	+24 VDC	+5 VDC or +24 VDC	+5 VDC or +24 VDC	+24 VDC
Axis card interface	0 ÷ 10V or 4 ÷ 20 mA	Serial SSI binary/gray	TTL 5Vpp - 150 KHz	±10 VDC or 4 ÷ 20 mA
Max speed	1 m/s	2 m/s	2 m/s	-
Max resolution	< 0.2 % FS	1 µm	1 µm (@ 0.15 m/s)	< 0.4 % FS
Linearity error **(2)**	< ±0.03% FS	< ± 0.01 % FS	< ± 0.001 % FS	< ±0.25% FS
Repeatability **(2)**	< ± 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

11 VALVE SETTINGS AND PROGRAMMING TOOLS

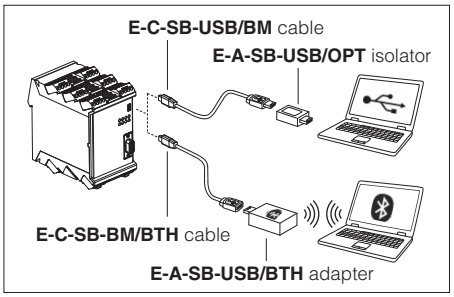
Valve's functional parameters and configurations, can be easily set and optimized using Atos Z-SW programming software connected via USB port to the digital axis card (see table **FS900**).
For fieldbus versions, the software permits valve's parameterization through USB port also if the axis card is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

The software is available in different versions according to the axis card options (see table **GS500**):

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

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

USB or Bluetooth connection



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

DVD programming software, to be ordered separately:

Z-SW-FULL DVD first supply = software has to be activated via web registration at ; 1 year service included
Upon web registration user receive via email the Activation Code (software license) and login data to access Atos Download Area

Z-SW-FULL-N DVD next supplies = only for supplies after the first; service not included, web registration not allowed
Software has to be activated with Activation Code received upon first supply web registration

Atos Download Area: direct access to latest releases of Z-SW software, manuals, USB drivers and fieldbus configuration files at **USB**

Adapters, Cables and Terminators, can be ordered separately

12 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-BM-KZ - user manual for **Z-BM-KZ**

12.1 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)

12.2 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

12.3 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 12.4)

12.4 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.)

12.5 Valve characteristics compensation

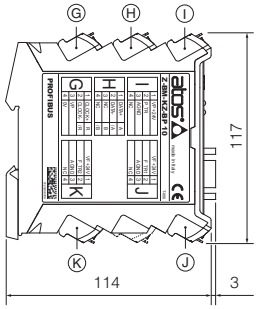
Allow to modify the valve regulation to match the actuator/system characteristics and to obtain the best overall performances:
- *Valve parameters* modify the standard valve regulation by means of deadband compensation, curve linearization and differentiated gain for positive and negative regulation

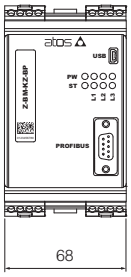
12.6 Motion phases parameters

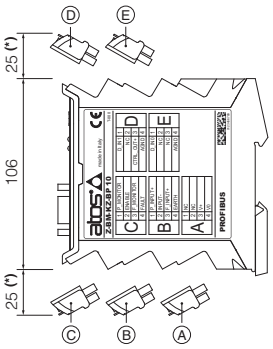
When the internal reference generation is active a pre-programmed cycle can be generated; start/stop/switch-over commands and reference generation types parameters can be set to design a customized sequence of motion phases adapted to the specific application requirements (see 4.2).

13 OVERALL DIMENSIONS [mm]

overall dimension with assembled connectors







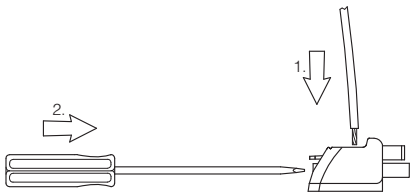
DIN rail dimensions

A,B,C,D,E,G,H,I,J,K connectors included

(*) Space to remove the connectors

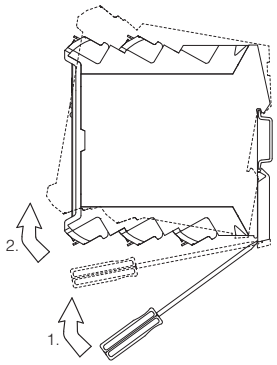
14 INSTALLATION

To wire cables in the connectors:
1. insert cable into the termination
2. turn screw with a screwdriver



Note: max conductor size: 2,5 mm²
tightening torque: 0,4 ÷ 0,6 Nm

To unlock the axis card from the DIN rail:
1. pull down the locking slide with a screwdriver
2. rotate up the axis card



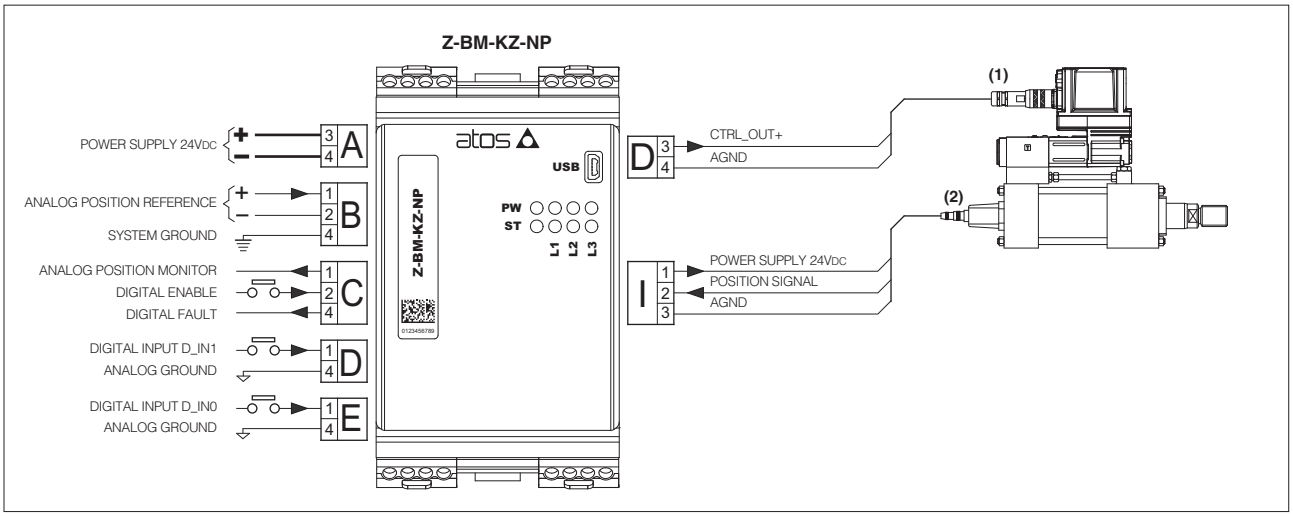
To extract the connectors:
1. push lever
2. pull connector

To insert the connectors:
1. push the connector in its slot

Note: all connectors are supplied with a mechanical coding. This feature ensures a unique insertion of each connector in the own slot (eg. connector A can not be inserted into connector slot of B,C,D,E,G,H,I,J,K)

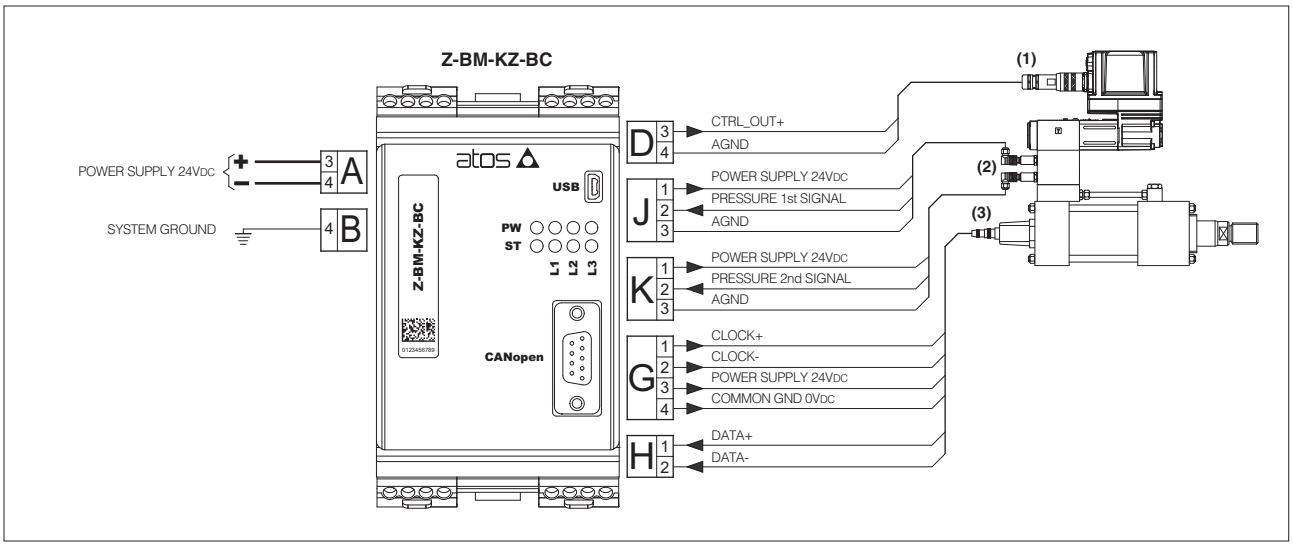
15 WIRING EXAMPLES

15.1 Position control - analog reference - analog position transducer



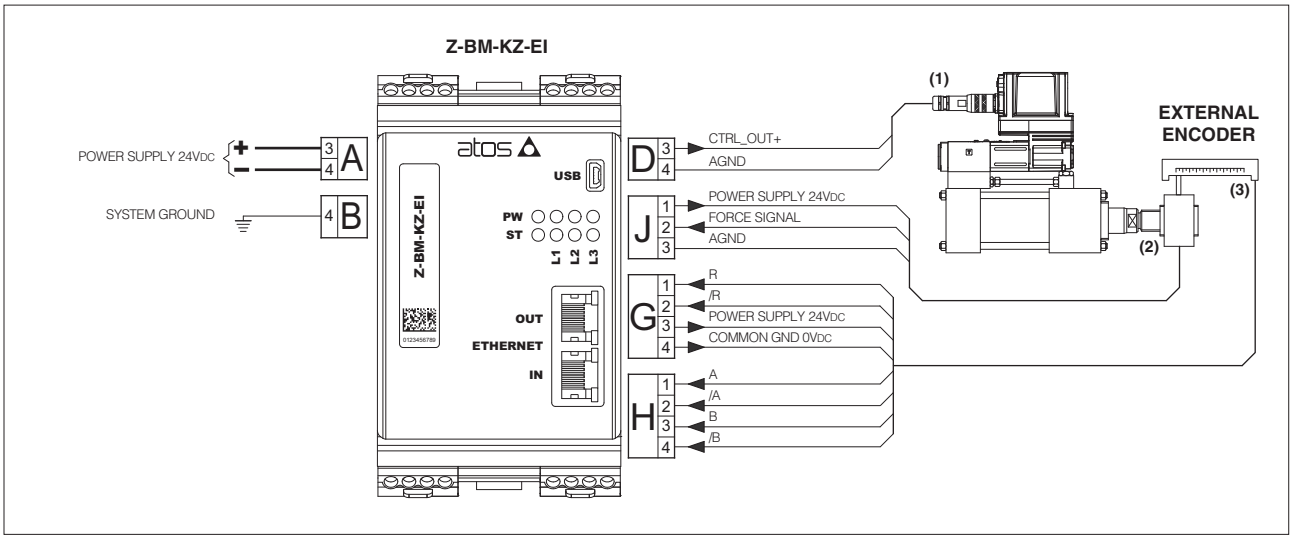
(1) For valve driver electrical connections please refer to the specific technical table
(2) The analog position transducer connections are intended as generic example, for details please consult the transducer datasheet

15.2 Alternated position/force control - CANopen reference - SSI position transducer - 2 analog pressure transducers



(1) For valve driver electrical connections please refer to the specific technical table
(2) Pressure transducers connections are shown with voltage signal output; for connections with current signal output see 8.5
(3) The SSI position transducer connections are intended as generic example, for details please consult the transducer datasheet

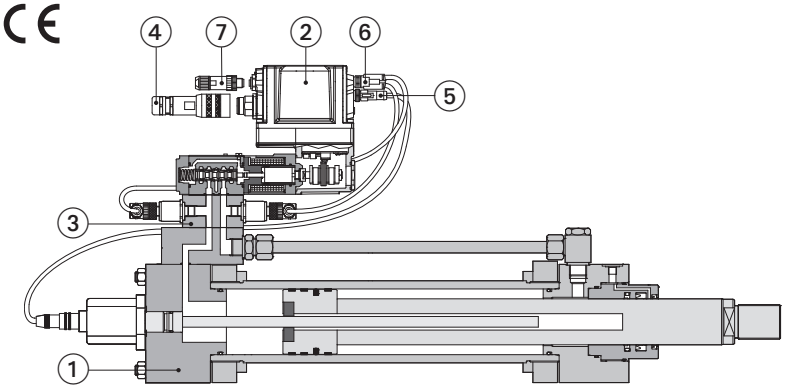
15.3 Alternated position/force control - EtherNet/IP reference - Encoder position transducer - analog load cell



(1) For valve driver electrical connections please refer to the specific technical table
(2) Load cell connections is shown with voltage signal output; please consult the load cell datasheet for details about connections
(3) The Encoder position transducer connections are intended as generic example, for details please consult the transducer datasheet

Digital electrohydraulic servoactuators

servocylinder plus servoproportional directional with on-board driver & axis card



***** AZC-D-SF-EH/CKM200/100D0500/V040**

① Servocylinder with on-board LVDT transducer
② Servoroportional valve with on-board digital driver + axis card
③ Block with double pressure transducer
④ Main connector
⑤ LVDT transducer connector
⑥ Pressure transducers connector
⑦ Fieldbus connectors

AZC

Digital electrohydraulic servoactuators are stand-alone units performing closed loop position controls.
The complete motion control cycle can be operated by external signals (from machine PLC) or programmed internally to the controller.
Alternate force control added to the basic position one with pressure transducers or load cell factory pre-assembled and wired.
The servoacuators are composed by a servocylinder with position transducer, servoproportional valve with on-board driver plus axis card, factory assembled and tested.
They can be provided with optional fieldbus interfaces for functional parameters setting, reference signals and real time diagnostics.
The USB interface is always present for connection to Atos PC software which allows to easily customize the AZC configuration to the specific application requirements.

1 MODEL CODE

***	AZC	M	-	D	-	SF	-	EH	/	CK	M	200	/	100	D	0500	/	V0	40

****
Design number

AZC
Digital electrohydraulic servoactuator for linear axis position control

Cycle Generation type:
- = none
I = injection
M = mold
P = parison
S = synchronism
X = positioning
9 = customized

Position transducer type:
A = analog
D = digital

Alternated P/Q controls:
SN = none
SF = with on-board double pressure transducer
SL = with on-board load cell transducer
XL = with remote load cell transducer

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

Servocylinder Type, tech table **B310**:
CN = ISO 6020-1, Pmax 250 bar - tech table **B180**
CK = ISO 6020-2, Pmax 250 bar - tech table **B137**
CH = ISO 6020-3, Pmax 250 bar - tech table **B160**
CC = ISO 6022, Pmax 320bar - tech table **B241**

Cylinder position transducer type, see section 6 :
Analog (only for AZC-A)
P = potentiometer, max stroke 900mm
F = analog magnetosonic, max stroke 2500mm
N = analog magnetostrictive, max stroke 4000mm
T = LVDT, max stroke 16mm
L = LVDT, max stroke 30mm
V = inductive, max stroke 900mm

Digital (only for AZC-D)
M = SSI magnetosonic, max stroke 900mm

Analog or Digital
9 = special
X = remoted

Bore diameter [mm]

Rod diameter [mm]

Rod:
S = single rod
D = double rod

Stroke [mm]

Servoproportional valve size with axis controller:
V0 = direct, size 06
V1 = direct or piloted, size 10
V2 = piloted size 16
V4 = piloted size 25 or size 27

Servoproportional valve configuration, zero spool overlap:
40 = with fail safe, sleeve execution, direct (tech table **FS610**)
60 = without fail safe, sleeve execution, direct (tech table **FS610**) or piloted (tech table **FS630**)
70 = spring central position, direct (tech table **FS620**) or piloted (tech table **FS630**)

2 MAIN CHARACTERISTICS

Assembly position		Any position	
Ambient temperature range		standard execution = -20°C ÷ +60°C	
Storage temperature range		Standard execution = -20°C ÷ +70°C	
Protection degree to EN60529		IP66 / IP67	
Duty factor		Continuous rating (ED=100%)	
Recommended fluid temperature		-20°C ÷ +60°C, with HFC hydraulic fluids = -20°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 KTF catalog
	longer life	ISO4406 class 16/14/11 NAS1638 class 5	

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

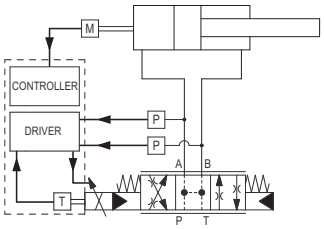
3 AXIS CONTROLLER

Digital servoproportionals direct or pilot operated include valve with on-board digital driver plus axis card to perform the position closed loop of hydraulic actuator. Axis controllers are operated by an external or internally generated reference position signal.
For detailed information about integral axis controller see tech tables **FS610**, **FS620**, **FS630**.

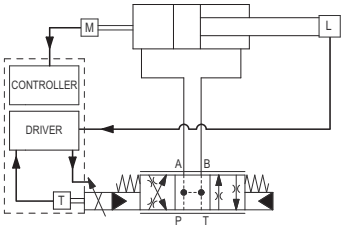
4 ALTERNATED P/Q CONTROLS

SF and **SL** controls add the alternated force closed loop control to the actuator standard position control.
A dedicated algorithm alternates pressure (force) depending on the actual hydraulic system conditions.
For detailed information about SF, SL controls, see tech table **FS500**.

SF



SL



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

5 FIELDBUS

Fieldbus allows the direct communication of the servoactuator with machine control unit for digital reference signal, diagnostics and settings of functional parameters. Analog reference signal remain available on the main connector for quick commissioning and maintenance.
For detailed information about fieldbus features and specification see tech table **GS510**.

6 ACTUATOR TRANSDUCER CHARACTERISTICS

6.1 Position transducers

The accuracy of the position control is strongly dependent to the selected position transducer. Four different transducer interfaces are available on the controllers, 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.

6.2 Pressure/force transducers

The accuracy of the force control is strongly dependent to the selected force transducer. 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.

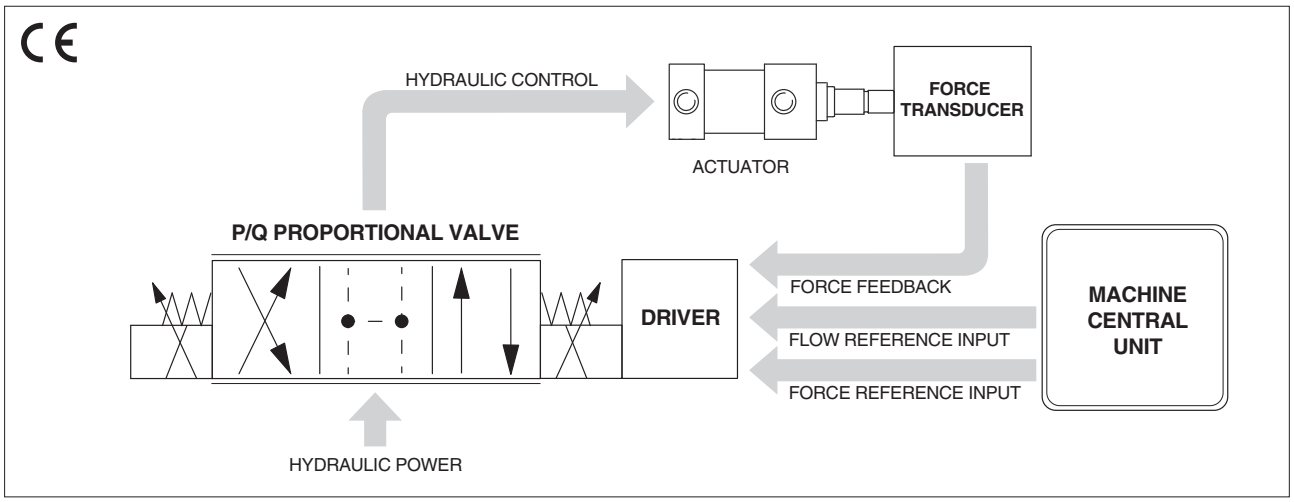
6.3 Transducers characteristics & interfaces - following values are just for reference, for details please consult the transducer's datasheet

	Position				Pressure/Force
Execution	A		D		SF, SL
Input type	Potentiometer	Analog	SSI **(3)**	Incremental Encoder	Analog
Power supply **(1)**	±10 VDC	+24 VDC	+5 VDC / +24 VDC	+5 VDC / +24 VDC	+24 VDC
Controller Interface	±10V	0 ÷ 10V 4 ÷ 20 mA	Serial SSI binary/gray	TTL 5Vpp - 150 KHz	±10 VDC 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 digital controller **(2)** percentage of total stroke **(3)** Balluff BTL7 with SSI interface is not supported

Digital proportional valves with P/Q control

directional valves with LVDT transducer and on-board driver



1 GENERAL DESCRIPTION

Proportional directional valves with P/Q control are identified by option SP, SF or SL and they are designed to perform the alternated regulation of speed/position/force of hydraulic actuators.
These options add the closed loop control of pressure (for SP) or force (for SF and SL) to the standard direction and flow regulation operated by the servoproportional and high performance proportional directional valves.

Note: for simplification, the following description always refers to the “force control”, even if for the SP option the control is the “pressure”.

The switching from the flow control to the force control is automatically performed by the valve thanks to a sophisticated algorithm.
The advantage offered by this solution is the high accurate and high dynamic control of the machine actuator in terms of direction, speed, position and force, all performed by a single valve.

2 FUNCTIONAL DESCRIPTION

The alternated P/Q control is operated by means of two electronic reference signals sent from the machine central unit to the valve driver: one for flow regulation and one for regulation. The valve driver has to be interfaced to a remote pressure transducer or to a load cell for the measurement and feedback of the actual pressure or force.
The SP option controls the pressure on A user port and it has to be interfaced to a single pressure transducer.
The SF option controls the force by measuring the delta p across A and B user ports and it has to be interfaced to two pressure transducers.
The SL option directly controls the actuator force and it has to be interfaced to a load cell.

See section 4 for configuration examples.

A dedicated algorithm automatically selects which control (flow or force) will be 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 or vibrations.
The flow regulation is active when the actual system force measured by the force transducer is lower than the relevant input reference signal.
The valve normally works to regulate the flow by controlling in closed-loop the spool position through the integral LVDT transducer.
The force control is activated when the actual system force, measured by remote transducers, reaches the setpoint defined by the relevant force reference input signal and meets the regulation requirements defined within the control algorithm.
The flow regulation is consequently reduced to keep steady the closed loop regulation of the force.
If the force decreases below its input reference signal, the flow control returns active.

The dynamic response of the force control can be adapted to different system characteristics, by setting the internal PID parameters using Atos PC software. Up to 4 different PIDs are selectable to optimize the system dynamic response according to different hydraulic working conditions.

3 VALVES RANGE

Options SP, SF, SL are available for high performance proportional directional valves and servoproportional valves with TES/LES on-board digital driver or TEZ/LEZ on-board digital driver + axis card.
Valve’s performance characteristics and overall dimensions remains unchanged as per standard valve models, refer to specific FS** technical tables.

Servoproportionals:
DLHZO-TES, DLKZOR-TES - direct, zero spool overlap, sleeve execution - technical tables **FS180**
DHZO-TES, DKZO-TES - direct, zero spool overlap - technical tables **FS168**
DPZO-LES - piloted, zero spool overlap - technical table **FS178**
LIQZO-LES, LIQZP-LES - 3-way servocartridges - technical table **FS340**

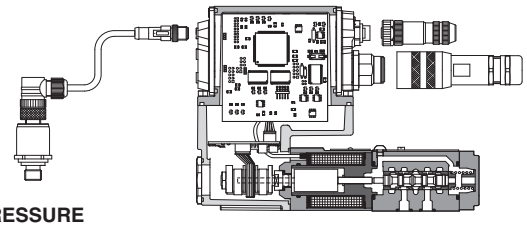
Servoproportionals with TEZ/LEZ on-board digital driver + axis card:

DLHZO-TEZ, DLKZOR-TEZ - direct, zero spool overlap, sleeve execution - technical tables **FS610**
DHZO-TEZ, DKZOR-TEZ - direct, zero spool overlap - technical tables **FS620**
DPZO-LEZ - piloted, zero spool overlap - technical tables **FS630**

High perfomance proportionals:
DHZO-TES, DKZOR-TES - direct, positive spool overlap - technical table **FS165**
DPZO-LES - piloted, positive spool overlap - technical table **FS175**

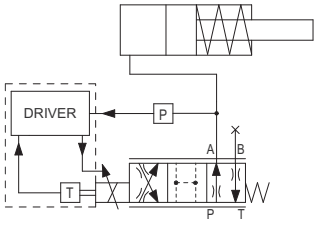
4 SP, SF, SL CONFIGURATION EXAMPLES

SP - Pressure Control - 1 pressure transducer



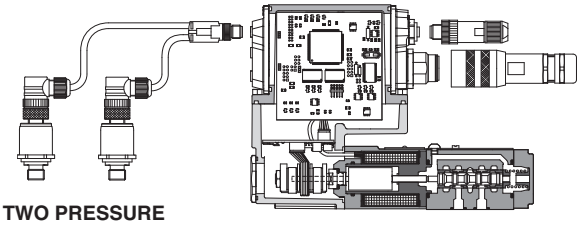
PRESSURE TRANSDUCER

e.g. DLHZO-TES- **SP** -BP PROFIBUS DP



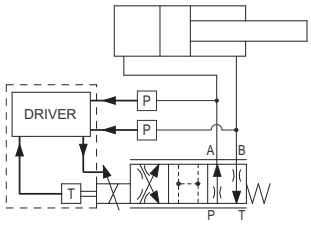
one remote pressure transducer has to be installed on the actuator's port to be controlled.
In this example the SP option regulates the pressure on port A

SF - Force Control - 2 pressure transducers



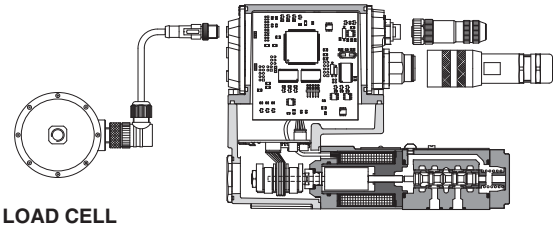
TWO PRESSURE TRANSDUCERS

e.g. DLHZO-TES- **SF** -EH EtherCAT



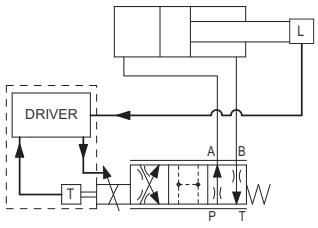
two remote pressure transducers have to be installed on the actuator's ports A and B.
The bore and rod dimensions of the actuator have to be input into the valve software, which calculates the relevant areas:
A1 = bore area; A2 = ring area
The SF option directly controls the actuator force (F) as result of the following calculation:
F = (Pa x A1) - (Pb x A2)

SL - Force Control - 1 load cell



LOAD CELL

e.g. DLHZO-TES- **SL** -EW POWERLINK



one load cell transducer has to be installed between the actuator and the controlled load
The SL option directly control the actuator force

5 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 E-SW-* programming software.

6 VALVE SETTINGS AND PROGRAMMING TOOLS

WARNING: the below operation must be performed in a safety area

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

The software is available in different versions according to the driver's options (see table **GS500**):

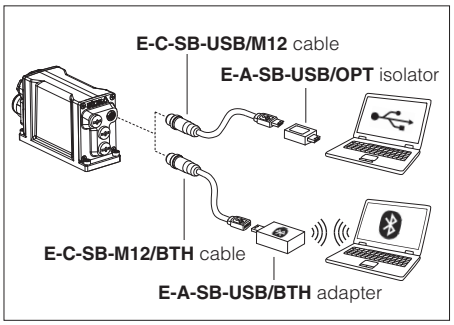
E-SW-BASIC/PQ supports: NP (USB)

E-SW-FIELDBUS/PQ and **Z-SW-FULL** support:

NP (USB)		
BC (CANopen)	BP (PROFIBUS DP)	EH (EtherCAT)
EW (POWERLINK)	EI (EtherNet/IP)	EP (PROFINET)

WARNING: drivers USB port is not isolated! For E-C-SB-USB/M12 cable, the use of isolator adapter is highly recommended for PC protection

USB or Bluetooth connection



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

7 FUNCTIONAL EXAMPLES

The following functional examples are just generic reference of the possible applications of with proportional directional valves with alternated P/Q control, **SP**, **SF**, **SL**.
Please contact Atos technical department for additional evaluations related to specific applications usage.

7.1 High-dynamic pressure reducing controls - only for **SP**

Directional proportional valves with zero spool overlap and SP control, are operated in 3-way hydraulic configuration to obtain high-dynamic pressure reducing control on the A (or B) user port:

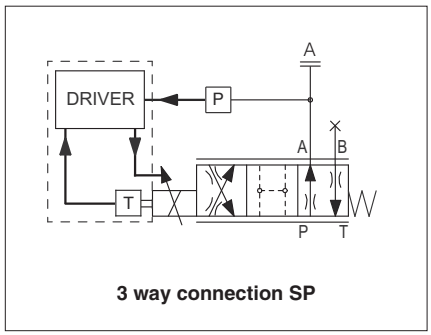
- flow reference signal is used to limit the maximum flow during the pressure regulation
- pressure reference signal is used to regulate the pressure on the valve's A user port; the rapid/repeatable response of the pressure control is performed in high dynamics by the directional valve's closed loop regulation

Requirements:

- an remote pressure transducer has to be installed in the hydraulic system on the controlled user port (when using 4 way valves either A or B port can be used while the not controlled port must be plugged)
- zero overlap valves without fail safe position are recommended;

⚠ Positive overlap valves with PABT ports closed in central position are not suitable for this application

High-dynamic - only for **SP**



3 way connection SP

7.2 Single effect actuators with speed/pressure/force controls - only for **SP** or **SL**

Directional proportional valves with SP or SL control, are operated in 3-way hydraulic configuration to control speed/pressure (force) on single effect actuators:

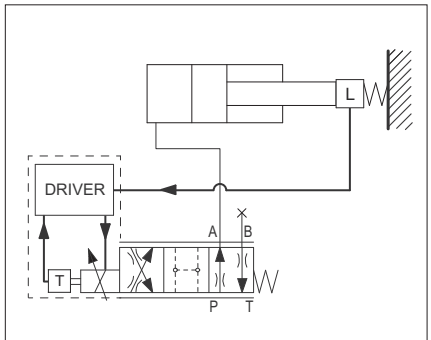
- flow reference signal is used to regulate the actuator's forward and backward speed while pressure (force) reference signal is used to limit the maximum pushing pressure (force) to the actuator
  or
- pressure (force) reference signal is used to regulate the actuator pushing pressure (force) while flow reference signal is used to limit the maximum actuator speed

Requirements:

- for SP control a remote pressure transducer has to be installed in the hydraulic system on the actuator pushing port
- for SL control a remote force transducer has to be installed between the actuator and the controlled load
- zero overlap valves without fail safe position are recommended;

⚠ Positive overlap valves with PABT ports closed in central position are not suitable for this application

Single effect - only for **SP** or **SL**



3 way connection SL

7.3 Double effect actuators with speed/pressure controls - only for **SP**

Directional proportional valves with SP control, regulate speed/pressure on double effect actuators:

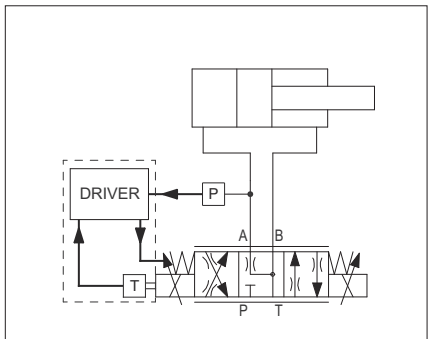
- flow reference signal is used to regulate the actuator's forward and backward speed while pressure reference signal is used to limit the maximum pushing pressure of the actuator
  or
- pressure reference signal is used to regulate the actuator pushing pressure while flow reference signal is used to limit the maximum forward and backward actuator speed

Requirements:

- a remote pressure transducer has to be installed on the actuator's pushing port
- a dedicated Q5 spool with strong "meter-in" characteristic in central position has to be used; during pressure regulation, the not controlled port remains connected to T line to avoid any back pressure - see section 7.4

⚠ Positive overlap valves with PABT ports closed are not suitable for this application

Double effect - only for **SP**



4 way connection SP

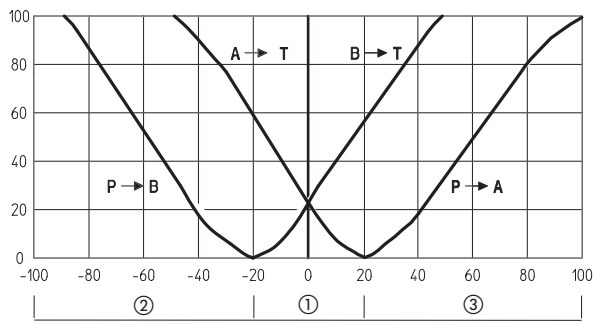
7.4 Q5 spool for 4 way connection with SP control

Spool type **Q5** allows fast direction reverse during motion phases (e.g. ejector motion with max strain limitation)

① depressuring (pressure control active)

② backward movements (flow control active)

③ forward movements (flow or pressure control active)



7.5 Double effect actuators with force limit/regulation - only for **SF** or **SL**

4 way directional proportional valves with SF or SL control, regulate speed/force on double effect actuators:

- flow reference signal is used to regulate the actuator's forward and backward speed while force reference signal is used to limit the maximum pushing and pulling force of the actuator

  or
- force reference signal is used to regulate the actuator pushing and pulling force while flow reference signal is used to limit the maximum actuator speed

Requirements:

- for SF two remote pressure transducers have to be installed on the both actuator's ports
- for SL one push/pull load cell transducer has to be installed between the actuator and the controlled load
- zero overlap valves are recommended;

⚠ positive overlap valves with PABT ports closed in central position are not suitable for this application

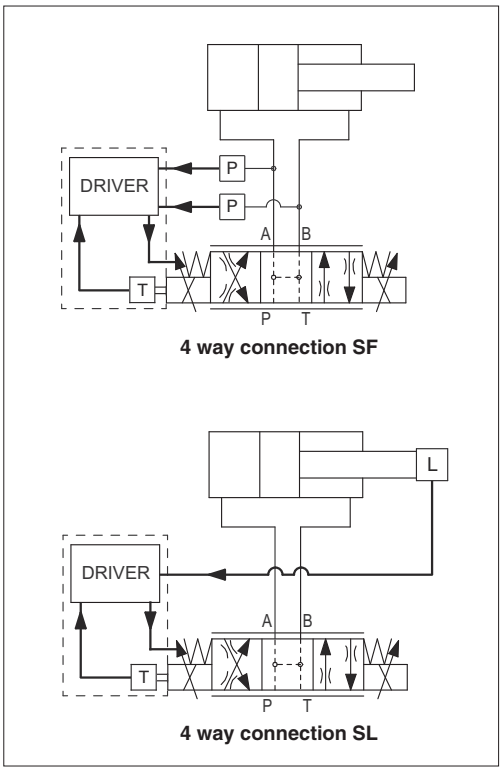
Advantages:

- force control is possible in both push and pull directions
- SL allows a more precise force control despite of a more complex installation of the load cell transducer
- SF allows to add force control also into existing systems thanks to the simple installation of pressure transducers

Control modes:

- Flow priority: flow reference signal is used to move forward and backward the actuator while force is limited/regulated in both push and pull direction
- Force priority: force reference signal is used to control both push and pull forces while flow is limited/regulated in both direction

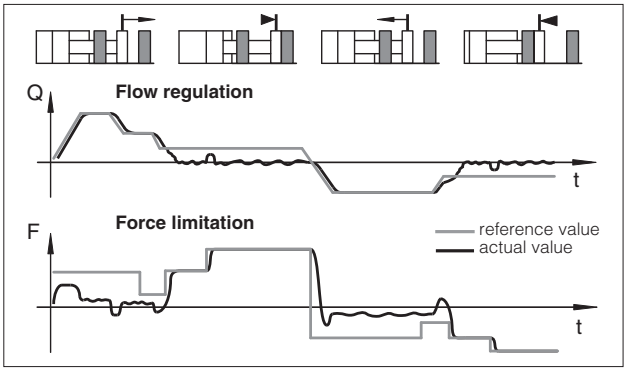
Double effect - only for **SF** or **SL**



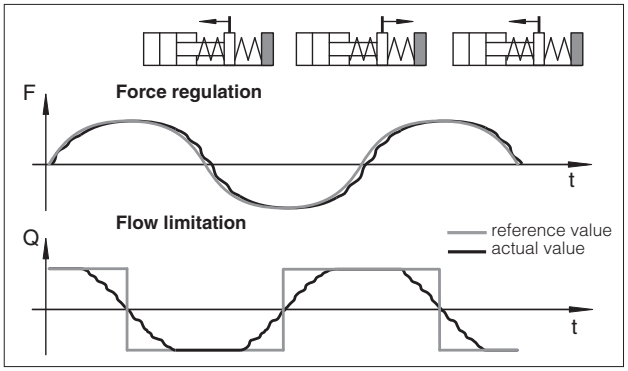
Notes:

auxiliary check valves are recommended to intercept A and B lines in case of specific hydraulic configuration requirements in absence of power supply or fault

7.6 Flow priority



7.7 Force priority



8 PRESSURE/FORCE TRANSDUCER CHARACTERISTICS

The accuracy of the pressure/force control is strongly dependent to the selected pressure/force transducers.

Pressure/force controls require to install remote pressure transducers or load cell to measure the actual pressure/force values:

- **Pressure Transducers:** allow easy system integration and cost effective solution for both pressure and force controls, see tech table **GS465** for E-ATR-8 pressure transducer details
- **Load Cell Transducers:** allow the user to get high accuracy and precise regulations for force control, but it increases the complexity of the mechanical installation

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.

Алматы (7273)495-231
Ангарск (3955)60-70-56
Архангельск (8182)63-90-72
Астрахань (8512)99-46-04
Барнаул (3852)73-04-60
Белгород (4722)40-23-64
Благовещенск (4162)22-76-07
Брянск (4832)59-03-52
Владивосток (423)249-28-31
Владикавказ (8672)28-90-48
Владимир (4922)49-43-18
Волгоград (844)278-03-48
Вологда (8172)26-41-59
Воронеж (473)204-51-73
Екатеринбург (343)384-55-89
Иваново (4932)77-34-06
Ижевск (3412)26-03-58
Иркутск (395)279-98-46
Казань (843)206-01-48
Калининград (4012)72-03-81
Калуга (4842)92-23-67
Кемерово (3842)65-04-62
Киров (8332)68-02-04
Коломна (4966)23-41-49
Кострома (4942)77-07-48
Краснодар (861)203-40-90
Красноярск (391)204-63-61
Курск (4712)77-13-04
Курган (3522)50-90-47
Липецк (4742)52-20-81
Магнитогорск (3519)55-03-13
Москва (495)268-04-70
Мурманск (8152)59-64-93
Набережные Челны (8552)20-53-41
Нижний Новгород (831)429-08-12
Новокузнецк (3843)20-46-81
Ноябрьск (3496)41-32-12
Новосибирск (383)227-86-73
Омск (3812)21-46-40
Орел (4862)44-53-42
Оренбург (3532)37-68-04
Пенза (8412)22-31-16
Петрозаводск (8142)55-98-37
Псков (8112)59-10-37
Пермь (342)205-81-47
Ростов-на-Дону (863)308-18-15
Рязань (4912)46-61-64
Самара (846)206-03-16
Саранск (8342)22-96-24
Санкт-Петербург (812)309-46-40
Саратов (845)249-38-78
Севастополь (8692)22-31-93
Симферополь (3652)67-13-56
Смоленск (4812)29-41-54
Сочи (862)225-72-31
Ставрополь (8652)20-65-13
Сыктывкар (8212)25-95-17
Тамбов (4752)50-40-97
Сургут (3462)77-98-35
Тверь (4822)63-31-35
Тольятти (8482)63-91-07
Томск (3822)98-41-53
Тула (4872)74-02-29
Тюмень (3452)66-21-18
Ульяновск (8422)24-23-59
Улан-Удэ (3012)59-97-51
Уфа (347)229-48-12
Хабаровск (4212)92-98-04
Чебоксары (8352)28-53-07
Челябинск (351)202-03-61
Череповец (8202)49-02-64
Чита (3022)38-34-83
Якутск (4112)23-90-97
Ярославль (4852)69-52-93

Россия (495)268-04-70
Казахстан (772)734-952-31
Киргизия (996)312-96-26-47

www.atos.nt-rt.ru ‖ aoy@nt-rt.ru