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www.atos.nt-rt.ru ‖ aoy@nt-rt.ru

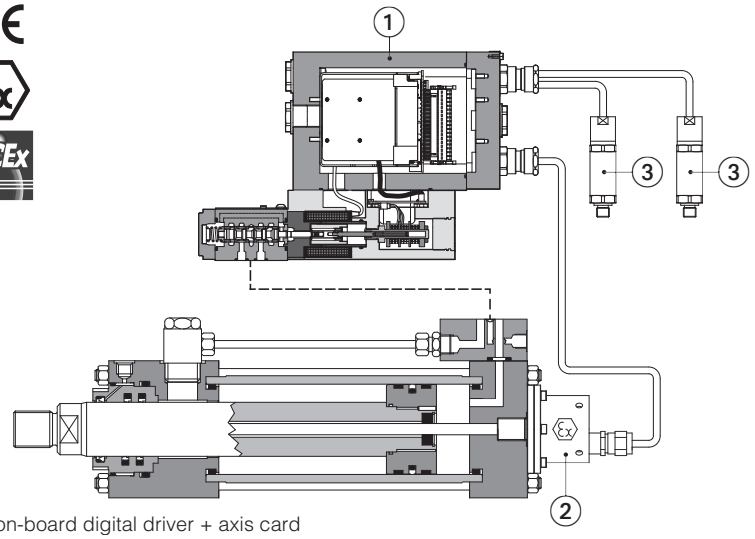
INDEX

AXIS & P/Q CONTROLS

Ex-d

Ex-proof digital servoproportionals with on-board axis card

direct, sleeve execution, with LVDT transducer and zero spool overlap - **ATEX and IECEx**



① on-board digital driver + axis card
② transducer to feedback the axis position
③ pressure/force transducers

DLHZA-TEZ-D-SF-EP-040

DLHZA-TEZ, DLKZA-TEZ

Ex-proof digital servoproportional valves equipped with on-board driver plus axis card, LVDT position transducer and zero spool overlap to perform the position control of any linear or rotative hydraulic actuator.

They are certified for safe operations in hazardous environments with potentially explosive atmosphere.

- Multicertification **ATEX** and **IECEx** for gas group **II 2G** and dust category **II 2D**

The controlled actuator has to be equipped with integral or external ex-proof transducer (analog, potentiometer, SSI or Encoder) to feedback the axis position.

The valve can be operated by an external or internally generated reference position signal, see section 2.

Options SF, SL add the alternated pressure/force control to the basic position one, see section 3.

DLHZA:
Size: **06** -ISO 4401
Max flow: **50 l/min**
Max pressure: **350 bar**

DLKZA:
Size: **10** -ISO 4401
Max flow: **100 l/min**
Max pressure: **315 bar**

1 MODEL CODE

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

Ex-proof servoproportional directional valves, direct
DLHZA = size 06
DLKZA = size 10

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

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

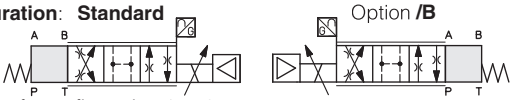
Alternated P/Q controls:
SN = none
SF = force control (2 pressure tranducers)
SL = force control (1 load cell)

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

Seals material, see section 10 :
- = NBR
PE = FKM
BT = HNBR

Series number

Hydraulic options (2):
B = solenoid with integral electronics and position transducer at side of port A **(3)**
Y = external drain

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

Cable entrance threaded connection:
M = M20x1,5

Fail safe configuration, see section 18 :

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)
DLHZA =	4	7	8	14	-	20	28	40
DLKZA =	-	-	-	60	60	-	-	100

Nominal flow (l/min) at Δp 70bar P-T

(1) Only for configuration **40** **(2)** For possible combined options, see section 16

(3) In standard configuration the solenoid with on-board digital driver and position transducer are at side port B

2 POSITION REFERENCE MODE

2.1 External reference generation

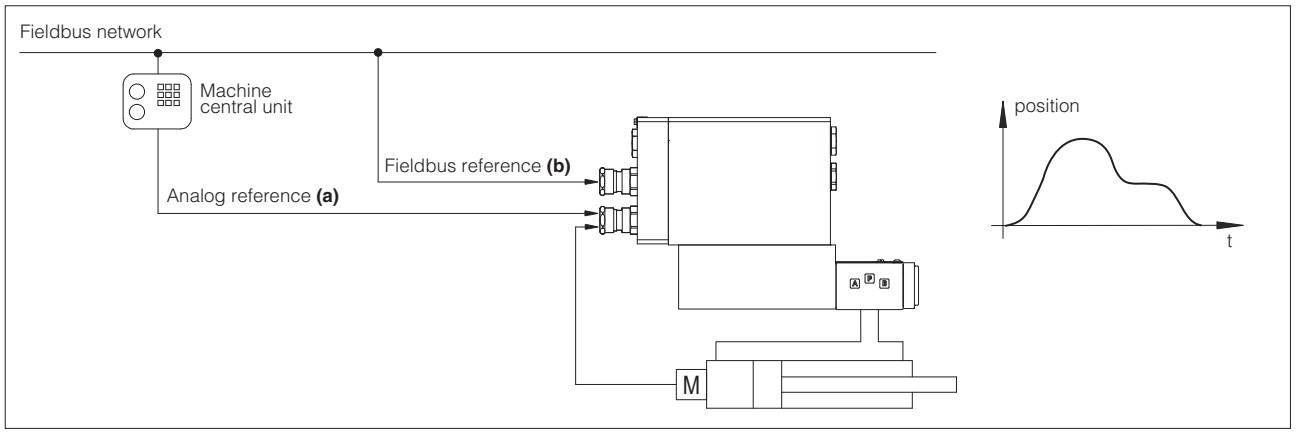
Axis controller regulates in closed loop the actuator position according to an external reference position signal and to the position feedback from the actuator transducer.

The external reference signal can be software selected among:

Analog reference (a) - the controller receives in real time the reference signal from the machine electronic central unit by means analog input on the terminal board.

Fieldbus reference (b) - the controller receives in real time the reference signal from the machine electronic central unit by means digital fieldbus communication.

For fieldbus communication details, please refer to the controller user manual.



2.2 Internal reference generation

Axis controller regulates in closed loop the actuator position according to an internally generated reference position signal and to the position feedback from the actuator transducer.

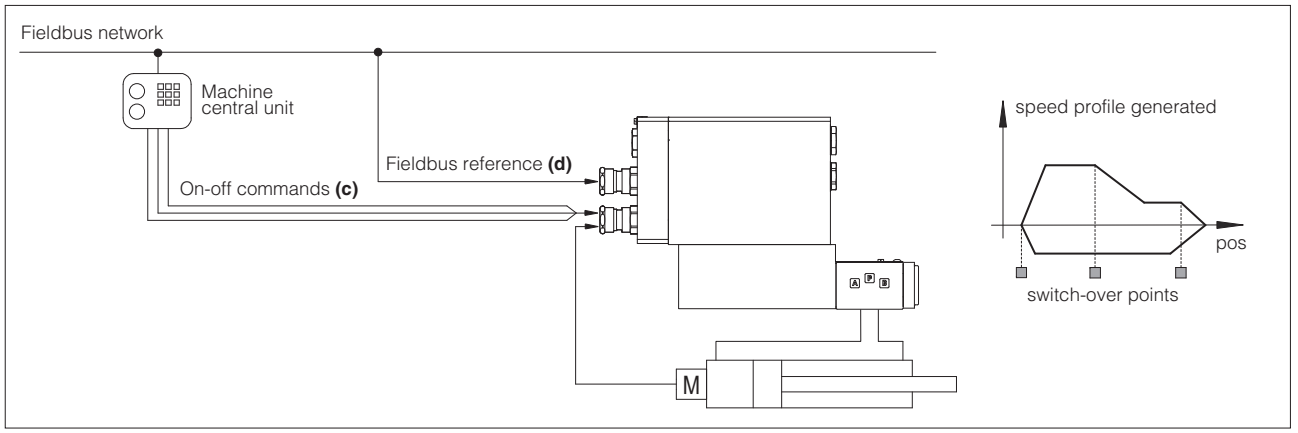
The internal reference signal is generated by a pre-programmed cycle; only start, stop and switch-over commands are required from the machine electronic central unit by means :

- on-off commands ***(c)***

- fieldbus commands ***(d)***

Atos PC software allows to design a customized sequence of motion phases adapted to the specific application requirements: a range of predefined standard sequences are available in the Z-SW software.

Start/stop/switch-over commands and reference generation type can be set for each phase in order to realize an automatic cycle according to the application requests. Refer to the controller user manual for further details on commands and reference generation type.



Start / stop / switch-over commands examples

External digital input	on-off commands, on terminal board, are used to start/stop the cycle generation or to change the motion phase
External fieldbus input	on-off commands, by fieldbus communication, are used to start/stop the cycle generation or to change the motion phase
Switch by position	switch-over from actual to following motion phase occurs when the actual position reaches a programmed value
Switch by time	switch-over from actual to following motion phase occurs after a fixed time, starting from the actual phase activation

Reference generation types examples

Absolute	a target position reference signal is internally generated for each motion phase; maximum speed and acceleration can be set to obtain a smooth and precise position control
Relative	as 'Absolute' but the target position corresponds to the actuator position plus a fixed quote internally set by software
Time	as 'Absolute' type but the controller automatically determines the speed and acceleration in order to reach the target absolute position in the fixed time internally set by software

3 ALTERNATED POSITION / FORCE CONTROL

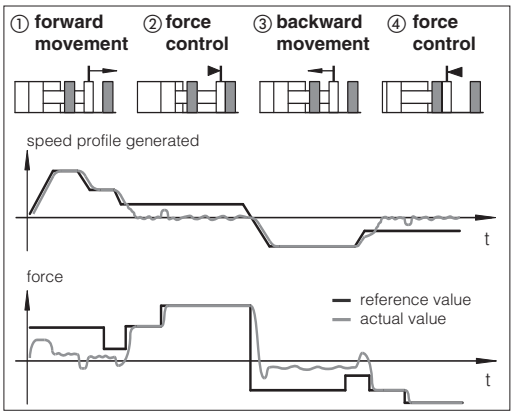
SF and **SL** options add the alternated force closed loop control to the actuator standard position control. Pressure or force remote transducers have to be installed on the actuator and interfaced to the valve driver, see below functional schemes.

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.

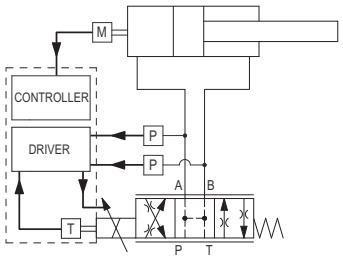
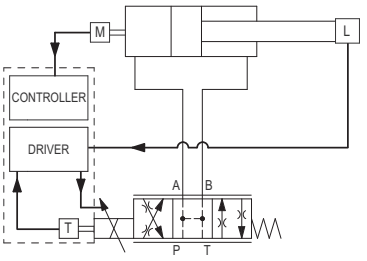
The dynamics of the switching between the two controls can be regulated thanks to specific software setting, in order to avoid instability and vibrations.

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 controller 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 **FX900** and in the user manuals included in the Z-SW-* programming software.

5 VALVE SETTINGS AND PROGRAMMING TOOLS

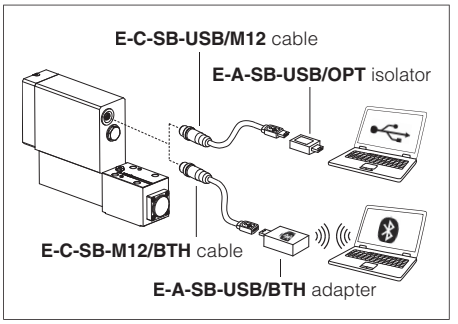
Valve's functional parameters and configurations, can be easily set and optimized using Atos Z-SW programming software connected via USB port to the digital controller (see table **GS003**).
For fieldbus versions, the software permits valve's parameterization through USB port also if the controller is connected to the central machine unit via fieldbus.

Z-SW-FULL support: NP (USB)
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: drivers 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 executions allow to operate the valves through fieldbus or analog signals available on the terminal board.

7 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 - salt spray test (ISO 9227) > 200 h
Compliance	Explosion proof protection, see section 11 -Flame proof enclosure “Ex d” -Dust ignition protection by enclosure “Ex t” RoHs Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006

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

Valve model		**DLHZA**											**DLKZA**						
Pressure limits [bar]		ports **P, A, B** = 350; **T** = 210 (250 with external drain /Y)											ports **P, A, B** = 315; **T** = 210 (250 with external drain /Y)						
Spool type		**L0**	**L1**	**V1**	**L3**	**V3**	**L5**	**T5**	**L7**	**T7**	**V7**	**D7**	**DT7**	**L3**	**T3**	**L7**	**T7**	**V7**	**D7**	**DT7**
Max flow [l/min]																				
Δp P-T	at Δp = 30 bar	2,5	4,5	8	9	13	18		26			26÷13		40		60			60÷33	
	at Δp = 70 bar	4	7	12	14	20	28		40			40÷20		60		100			100÷50	
	max permissible flow	5	9	16	18	26	32		50			50÷28		70		100			100÷50	
Δp max P-T [bar]		120	120	120	120	120	100		100			100		90		70			70	
Leakage [cm³/min] at P = 100 bar **(1)**		<100	<200	<100	<300	<150	<500	<200	<900	<200	<200	<700	<200	<1000	<400	<1500	<400	<400	<1200	<400
Response time **(2)** [ms]		≤ 13												≤ 20						
Hysteresis [% of max regulation]		≤ 0,1												≤ 0,1						
Repeatibility [% of max regulation]		± 0,1												± 0,1						
Thermal drift		zero point displacement < 1% at ΔT = 40°C																		

(1) referred to spool in neutral position and 50°C oil temperature
(2) 0-100% step signal

9 ELECTRICAL CHARACTERISTICS

Power supplies	Nominal : +24 VDC Rectified and filtered : VRMS = 20 ÷ 32 VMAX (ripple max 10 % VPP)			
Max power consumption	35 W			
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-ATRA-7 see tech table **GX800**)			
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 by 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

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

10 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	

⚠ The ignition temperature of the hydraulic fluid must be 50°C higher than the max solenoid surface temperature

(1) Performance limitations in case of flame resistant fluids with water:
-max operating pressure = 210 bar
-max fluid temperature = 50°C

11 CERTIFICATION DATA

Valve type	DLHZA, DLKZA				
Certifications	Multicertification Group II **ATEX IECEx**				
Solenoid certified code	**OZA-TEZ**				
Type examination certificate **(1)**	• ATEX: TUV IT 18 ATEX 068 X		• IECEx: IECEx TPS 19.0004X		
Method of protection	• ATEX 2014/34/EU Ex II 2G Ex db IIC T6/T5/T4 Gb Ex II 2D Ex tb IIIC T85°C/T100°C/T135°C Db		• IECEx Ex db IIC T6/T5/T4 Gb Ex tb IIIC T85°C/T100°C/T135°C Db		
Temperature class	**T6**		**T5**		**T4**
Surface temperature	≤ 85 °C		≤ 100 °C		≤ 135 °C
Ambient temperature **(2)**	-40 ÷ +40 °C		-40 ÷ +55 °C		-40 ÷ +70 °C
Applicable Standards	EN 60079-0	EN 60079-1	EN 60079-31	IEC 60079-0	IEC 60079-1	IEC 60079-31
Cable entrance: threaded connection	**M** = M20x1,5				

(1) The type examinator certificates can be downloaded from

(2) The controller and solenoids are certified for minimum ambient temperature -40°C.
In case the complete valve must withstand with minimum ambient temperature -40°C, select **/BT** in the model code.

⚠ **WARNING: service work performed on the valve by the end users or not qualified personnel invalidates the certification**

12 CABLE SPECIFICATION AND TEMPERATURE - Power supply and grounding cables have to comply with following characteristics:

Power supply and signals: section of wire = 1,0 mm² **Grounding:** section of external ground wire = 4 mm²

12.1 Cable temperature

The cable must be suitable for the working temperature as specified in the "safety instructions" delivered with the first supply of the products.

Max ambient temperature [°C]	Temperature class	Max surface temperature [°C]	Min. cable temperature [°C]
40 °C	T6	85 °C	80 °C
55 °C	T5	100 °C	90 °C
70 °C	T4	135 °C	110 °C

13 CABLE GLANDS

Cable glands with threaded connections M20x1,5 for standard or armoured cables have to be ordered separately, see tech table **KX800**

Note: a Loctite sealant type 545, should be used on the cable gland entry threads

14 HYDRAULIC OPTIONS

B = Solenoid, integral electronics and position transducer at side of port A of the main stage. For hydraulic configuration vs reference signal, see 17.1

Y = Option /Y is mandatory if the pressure in port T exceeds 210 bar

15 ELECTRONIC OPTIONS

I = It provides 4 ÷ 20 mA current reference 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.
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 = Only for **SF, SL**
Option /C 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

For SN: /BI, /BY, /IY

For SF, SL: /BI, /BY, /IY, /CI, /BCI, CIY, BCIY

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

17.1 Regulation diagrams

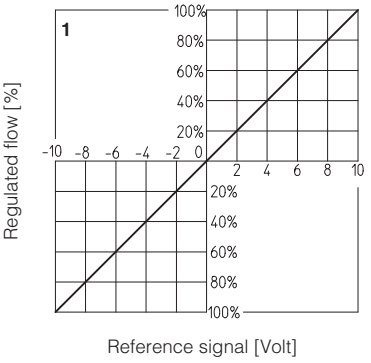
1 = Linear spools L
2 = Differential - linear spool D7

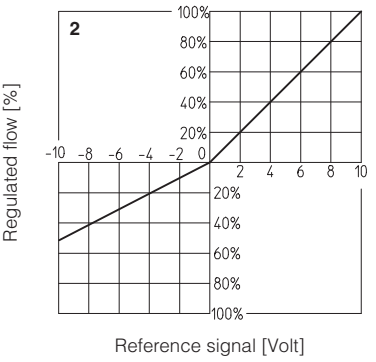
3 = Differential non linear spool DT7
4 = Non linear spool T5 (only for DLHZA)

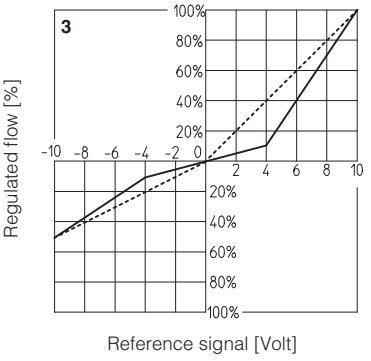
5 = Non linear spool, T3 (only for DLKZA) and T7
6 = Progressive spool V

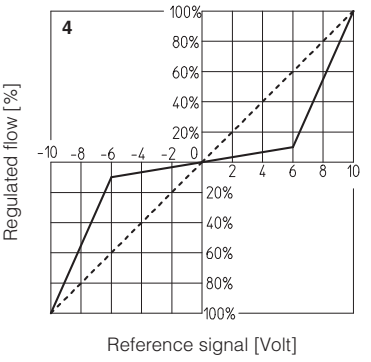
T5 and T7 spool types are specific for fine low flow control in the range from 0 to 60% (T5) and 0 to 40% (T3 and T7) of max spool stroke.
The non linear characteristics of the spool is compensated by the electronic driver, so the final valve regulation is resulting linear respect the reference signal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

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









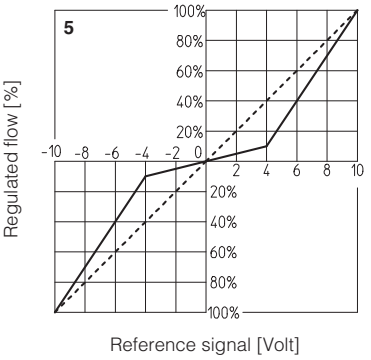
Note:
Hydraulic configuration vs. reference signal:

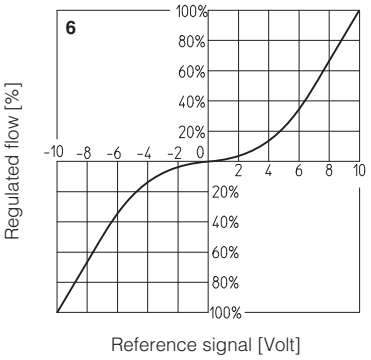
Standard:
Reference signal 0 ÷ +10 V / 12 ÷ 20 mA } P → A / B → T

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

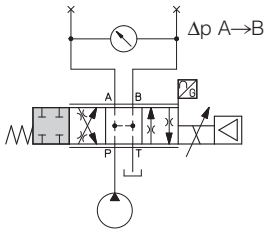
option /B:
Reference signal 0 ÷ +10 V / 12 ÷ 20 mA } P → B / A → T

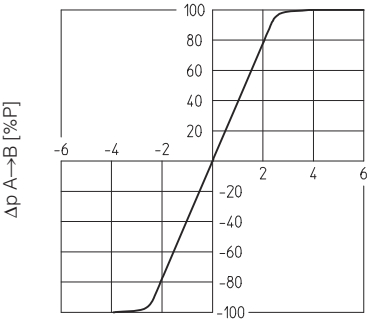
Reference signal 0 ÷ -10 V / 12 ÷ 4 mA } P → A / B → T





17.2 Pressure gain



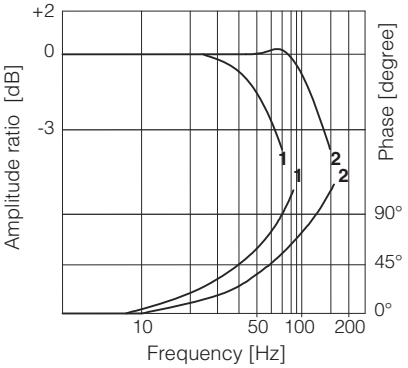


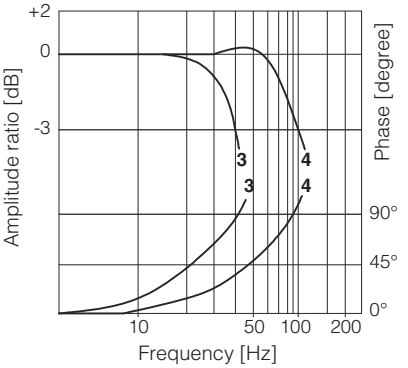
17.3 Bode diagrams

Stated at nominal hydraulic conditions

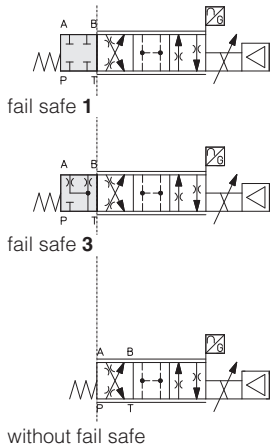
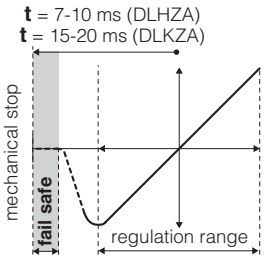
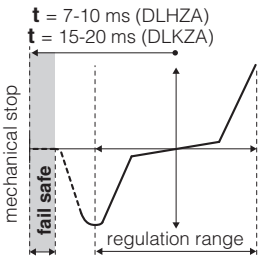
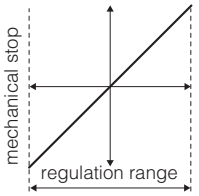
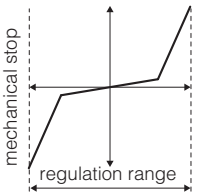
DLHZA:
1 = ± 100% nominal stroke
2 = ± 5% nominal stroke

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





18 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)** DLHZA	Fail safe 3	-	-	15÷30	10÷20
Flow [l/min] **(2)** DLKZA	Fail safe 3	-	-	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

19 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, EN-982).

19.1 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: 2,5 A time lag fuse.

19.2 Power supply for driver's logic and communication (VL+ and VL0)

The power supply for controller's logic and communication must be appropriately stabilized or rectified and filtered: apply at least a 10000 μF/40 V capacitance to single phase rectifiers or a 4700 μF/40 V capacitance to three phase rectifiers.
The separate power supply for controller's logic on pin 3 and 4, allow to remove solenoid power supply from pin 1 and 2 maintaining active the diagnostics, USB and fieldbus communications.

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

19.3 Position reference input signal (P_INPUT+)

Functionality of P_INPUT+ signal (pin 10), depends on controller's reference mode, see section 2 :

External analog reference generation (see 2.1): input is used as reference for the controller axis position 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.

Fieldbus/internal reference generation (see 2.2)*:* analog reference input signal can be used as on-off commands with input range 0 ÷ 24VDC.

19.4 Pressure or force reference input signal (F_INPUT+) - only for **SF**, **SL**

Functionality of F_INPUT+ signal (pin 12), depends on selected controllers' reference mode and alternated control options, see section 3 :

SF, SL controls and external analog reference selected : input is used as reference for the controller pressure/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/internal reference selected: analog reference input signal can be used as on-off commands with input range 0 ÷ 24VDC.

19.5 Position monitor output signal (P_MONITOR)

The controller generates an analog output signal (pin 9) proportional to the actual axis position; the monitor output signal can be software set to show other signals available in the controller (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.

19.6 Pressure or force monitor output signal (F_MONITOR) - only for **SF**, **SL**

The controller generates an analog output signal (pin 11) according to alternated pressure/force control option:

SN control: output signal is proportional to the actual valve spool position

SF, SL 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 controller (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.

19.7 Enable input signal (ENABLE)

To enable the controller, a 24VDC voltage has to be applied on pin 6.
When the Enable signal is set to zero the controller 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)

19.8 Fault output signal (FAULT)

Fault output signal indicates fault conditions of the controller (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.

19.9 Position transducer input signal

A position transducer must be always directly connected to the controller. Select the correct controller 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 20.1).

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

Analog remote pressure transducers or load cell can be directly connected to the controller.
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 20.2).

20 ACTUATOR'S TRANSDUCER CHARACTERISTICS

20.1 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.

20.2 Pressure/force transducers

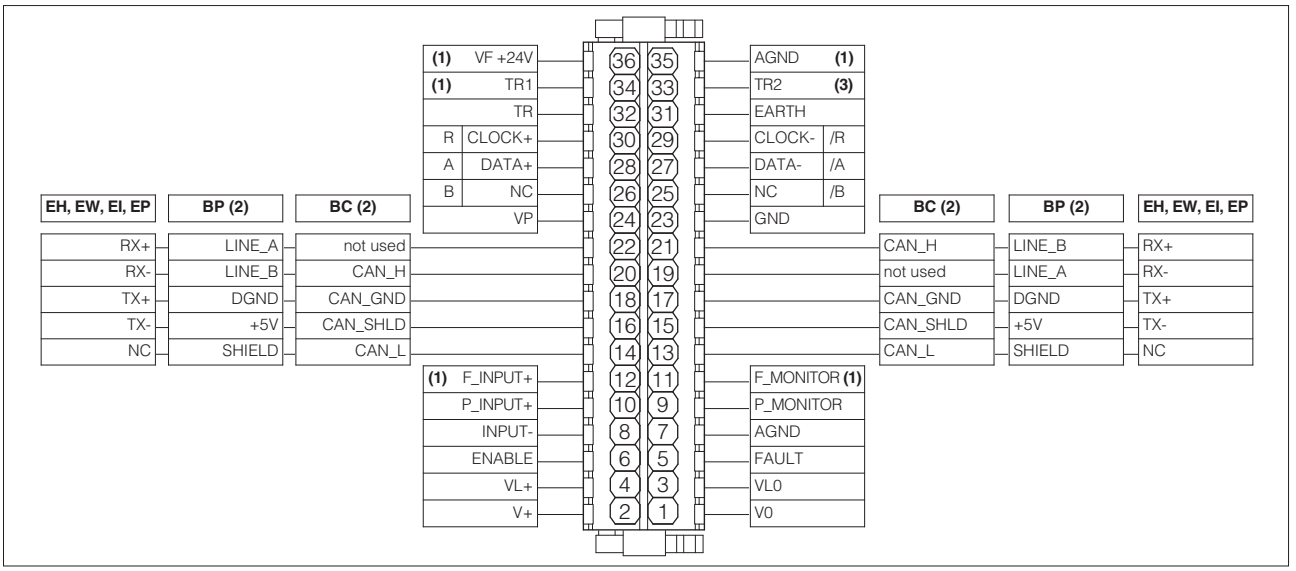
The accuracy of the pressure/force control is strongly dependent to the selected pressure/force transducer, see section 3 .
Alternated pressure/force controls require to install pressure transducers or load cell to measure the actual pressure/force values.
Pressure transducers allow easy system integration and cost effective solution for both alternated position/pressure and position/force controls (see tech table **GX800** 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.

20.3 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 Atos controller **(2)** Percentage of total stroke **(3)** For Balluff BTL7 with SSI interface only special code SA433 is supported

21 TERMINAL BOARD OVERVIEW



(1) Connections available only for **SF**, **SL**
(2) For BC and BP executions the fieldbus connections have an internal pass-through connection
(3) Connection available only for **SF**

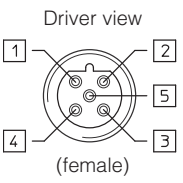
22 ELECTRONIC CONNECTIONS

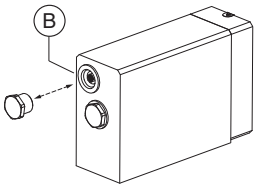
22.1 Main connections signals

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
A	1	**V0**	Power supply 0 VDC	Gnd - power supply
	2	**V+**	Power supply 24 VDC	Input - power supply
	3	**VL0**	Power supply 0 VDC for driver's logic and communication	Gnd - power supply
	4	**VL+**	Power supply 24 VDC for driver's logic and communication	Input - power supply
	5	**FAULT**	Fault (0 VDC) or normal working (24 VDC), referred to VL0	Output - on/off signal
	6	**ENABLE**	Enable (24 VDC) or disable (0 VDC) the driver, referred to VL0	Input - on/off signal
	7	**AGND**	Analog ground	Gnd - analog signal
	8	**INPUT-**	Negative reference input signal for P_INPUT+ and F_INPUT+	Input - analog signal
	9	**P_MONITOR**	Position monitor output signal: ±10 VDC / ±20 mA maximum range, referred to AGND Defaults are: ±10 VDC for standard and 4 ÷ 20 mA for /I option	Output - analog signal **Software selectable**
	10	**P_INPUT+**	Position reference input signal: ±10 VDC / ±20 mA maximum range Defaults are: ±10 VDC for standard and 4 ÷ 20 mA for /I option	Input - analog signal **Software selectable**
	11	**F_MONITOR**	Pressure/Force (SF, SL controls) or valve spool position (SN control) monitor output signal: ±10 VDC / ±20mA maximum range, referred to AGND Defaults are: ±10 VDC for standard and 4 ÷ 20 mA for /I option	Output - analog signal **Software selectable**
	12	**F_INPUT+**	Pressure/Force reference input signal (SF, SL controls): ±10 VDC / ±20 mA max. range Defaults are: ±10 VDC for standard and 4 ÷ 20 mA for /I option	Input - analog signal **Software selectable**
	31	**EARTH**	Internally connected to driver housing	

22.2 USB connector - M12 - 5 pin always present

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
B	1	**+5V_USB**	Power supply
	2	**ID**	Identification
	3	**GND_USB**	Signal zero data line
	4	**D-**	Data line -
	5	**D+**	Data line +





22.3 BC fieldbus execution connections

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
C1	14	**CAN_L**	Bus line (low)
	16	**CAN_SHLD**	Shield
	18	**CAN_GND**	Signal zero data line
	20	**CAN_H**	Bus line (high)
	22	**not used**	Pass-through connection **(1)**

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
C2	13	**CAN_L**	Bus line (low)
	15	**CAN_SHLD**	Shield
	17	**CAN_GND**	Signal zero data line
	19	**not used**	Pass-through connection **(1)**
	21	**CAN_H**	Bus line (high)

(1) Pin 19 and 22 can be fed with external +5V supply of CAN interface

22.4 BP fieldbus execution connections

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
C1	14	**SHIELD**	
	16	**+5V**	Power supply
	18	**DGND**	Data line and termination signal zero
	20	**LINE_B**	Bus line (low)
	22	**LINE_A**	Bus line (high)

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
C2	13	**SHIELD**	
	15	**+5V**	Power supply
	17	**DGND**	Data line and termination signal zero
	19	**LINE_A**	Bus line (high)
	21	**LINE_B**	Bus line (low)

22.5 EH, EW, EI, EP fieldbus execution connections

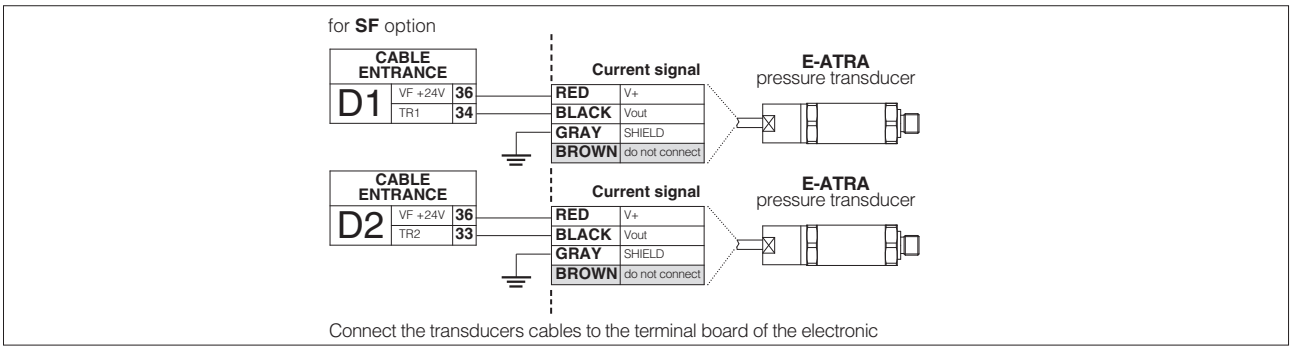
CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
C1 (input)	14	**NC**	do not connect
	16	**TX-**	Transmitter
	18	**TX+**	Transmitter
	20	**RX-**	Receiver
	22	**RX+**	Receiver

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
C2 (output)	13	**NC**	do not connect
	15	**TX-**	Transmitter
	17	**TX+**	Transmitter
	19	**RX-**	Receiver
	21	**RX+**	Receiver

22.6 Remote pressure transducer connections - only for **SF**, **SL**

CABLE ENTRANCES	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES	SL - Single transducer (1) Voltage	SL - Single transducer (1) Current	SF - Double transducers (1) Voltage	SF - Double transducers (1) Current
D1 D2	33	**TR2**	2nd signal transducer ±10 VDC / ±20 mA maximum range	Input - analog signal **Software selectable**	/	/	Connect	Connect
	34	**TR1**	1st signal transducer ±10 VDC / ±20 mA maximum range	Input - analog signal **Software selectable**	Connect	Connect	Connect	Connect
	35	**AGND**	Common gnd for transducer power and signals	Common gnd	Connect	/	Connect	/
	36	**VF +24V**	Power supply +24VDC	Output - power supply	Connect	Connect	Connect	Connect

E-ATRA remote pressure transducer connection - see tech table **GX800**

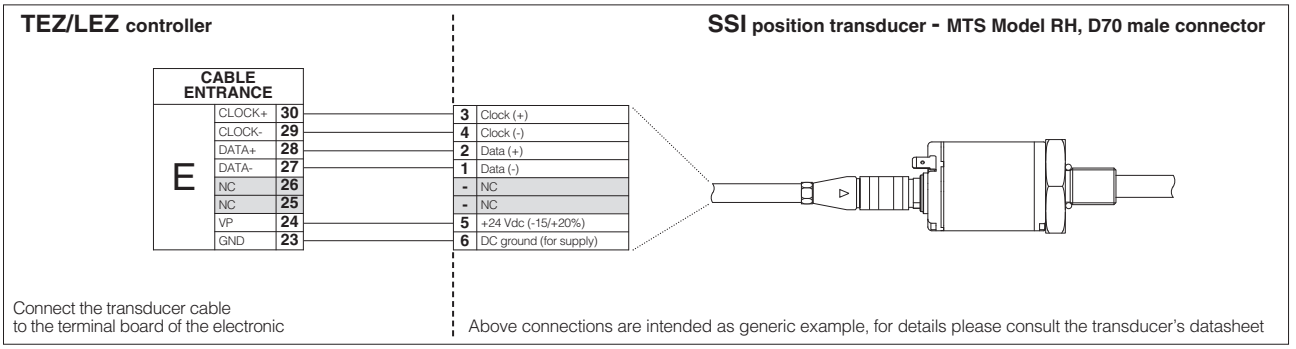


22.7 D execution - Digital position transducers connections

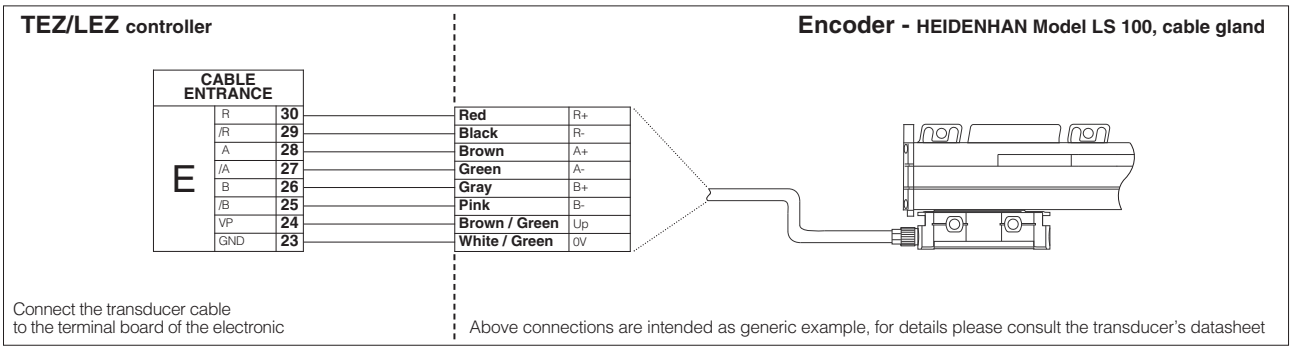
CABLE ENTRANCE	PIN	SSI - default transducer (1)			Encoder (1)		
		SIGNAL	TECHNICAL SPECIFICATION	NOTES	SIGNAL	TECHNICAL SPECIFICATION	NOTES
E	30	**CLOCK+**	Serial syncronous clock (+)	Input - digital signal	**R**	Input channel R	Input - digital signal
	29	**CLOCK-**	Serial syncronous clock (-)		**/R**	Input channel /R	
	28	**DATA+**	Serial position data (+)		**A**	Input channel A	
	27	**DATA-**	Serial position data (-)		**/A**	Input channel /A	
	26	**NC**	Not connect	Do not connect	**B**	Input channel B	
	25	**NC**			**/B**	Input channel /B	
	24	**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**
	23	**GND**	Common gnd for transducer powerand signals	Common gnd	**GND**	Common gnd for transducer power and signals	Common gnd

(1) Digital position transducer type is software selectable: Encoder or SSI, see 19.9

SSI connection - example



Encoder connection - example



22.8 A execution - Analog position transducers connector

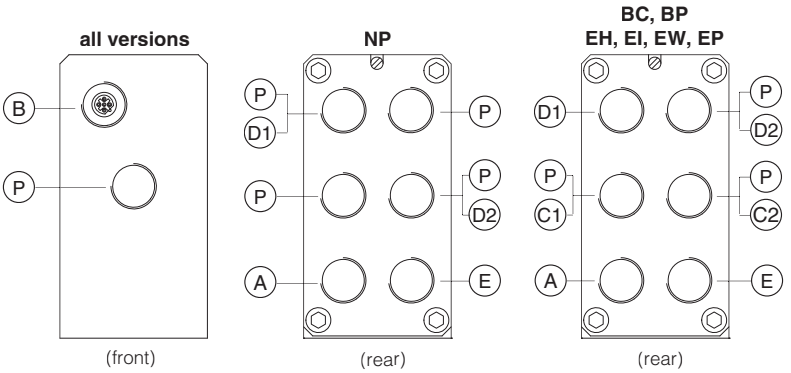
CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATION	NOTES
E	32	**TR**	Signal transducer	Input - analog signal
	24	**VP**	Power supply: +24VDC or OFF (default OFF)	Output - power supply **Software selectable**
	23	**GND**	Common gnd for transducer power and signals	Common gnd

23 CONNECTIONS LAYOUT

CABLE ENTRANCE OVERVIEW

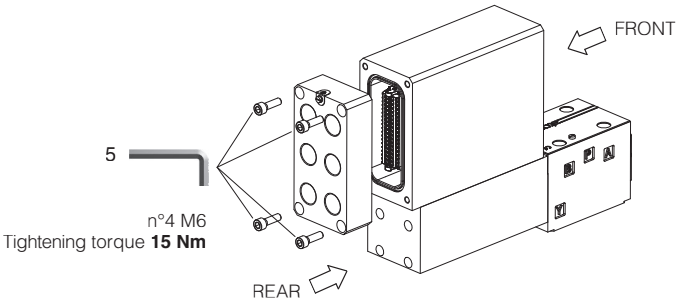
Cables entrance description:

- (A) main connections
- (B) USB connector always present (factory plugged)
- (C1) fieldbus (input)
- (C2) fieldbus (output)
- (D1) pressure transducer 1
- (D2) pressure transducer 2
- (E) position transducer
- (P) threaded plug



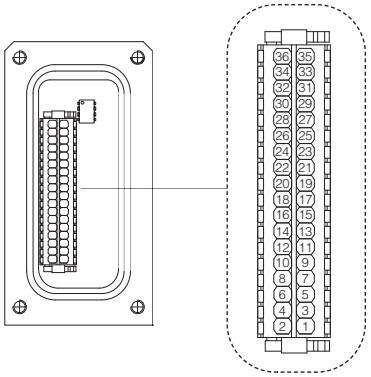
TERMINAL BOARD AND FIELDBUS TERMINATOR

Remove the 4 screws of driver's rear cover to access terminal board and fieldbus terminator

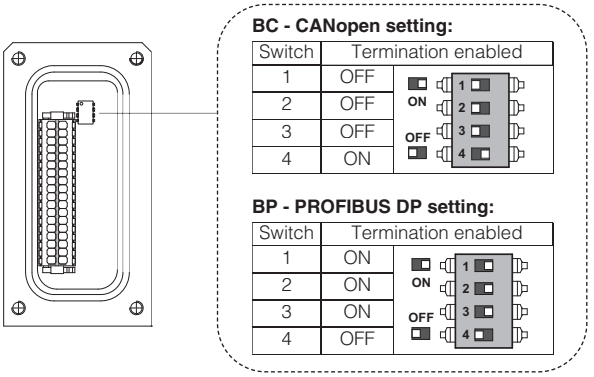


⚠ **WARNING:** the above operation must be performed in a safety area

Terminal board - see section 21



Fieldbus terminator only for BC and BP executions **(1)**



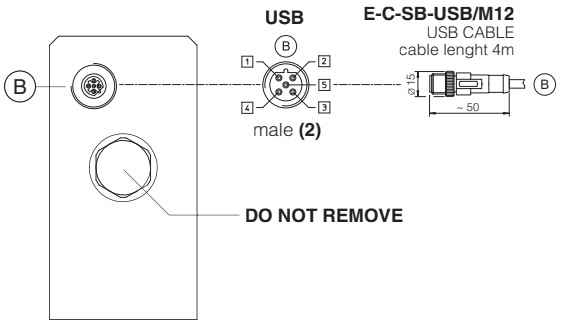
BC - CANopen setting:

Switch	Termination enabled
1	OFF
2	OFF
3	OFF
4	ON

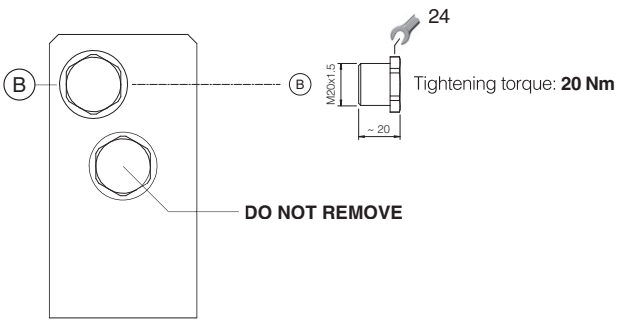
BP - PROFIBUS DP setting:

Switch	Termination enabled
1	ON
2	ON
3	ON
4	OFF

USB CONNECTOR

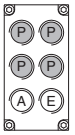
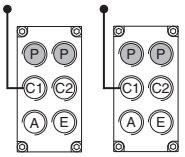
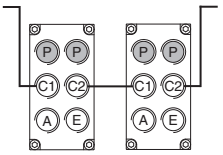


METALLIC PROTECTION CAP - supplied with the valves

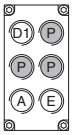
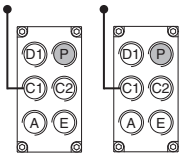
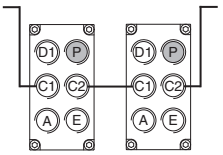


(1) Drivers with BC and BP fieldbus interface are delivered by default 'Not Terminated'. All switches are set OFF
(2) Pin layout always referred to driver's view

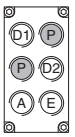
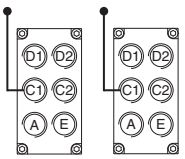
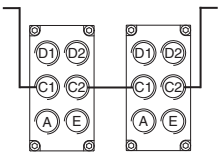
23.1 Cable glands and threaded plug for SN - see tech table **KX800**

Communication interfaces	To be ordered separately				Cable entrance overview	Notes
	Cable gland quantity	Cable gland entrance	Threaded plug quantity	Threaded plug entrance		
NP	2	A - E	none	none		Cable entrance A, E are open for costumers Cable entrance P are factory plugged
BC, BP, EH, EW, EI, EP "via stub" connection	3	C1 A - E	1	C2		Cable entrance A, E, C1, C2 are open for costumers Cable entrance P are factory plugged
BC, BP, EH, EW, EI, EP "daisy chain" connection	4	C1 - C2 A - E	none	none		Cable entrance A, E, C1, C2 are open for costumers Cable entrance P are factory plugged

23.2 Cable glands and threaded plug for SL - see tech table **KX800**

Communication interfaces	To be ordered separately				Cable entrance overview	Notes
	Cable gland quantity	Cable gland entrance	Threaded plug quantity	Threaded plug entrance		
NP	3	D1 A - E	none	none		Cable entrance A, E, D1 are open for costumers Cable entrance P are factory plugged
BC, BP, EH, EW, EI, EP "via stub" connection	4	D1 C1 A - E	1	C2		Cable entrance A, E, C1, C2, D1 are open for costumers Cable entrance P are factory plugged
BC, BP, EH, EW, EI, EP "daisy chain" connection	5	D1 C1 - C2 A - E	none	none		Cable entrance A, E, C1, C2, D1 are open for costumers Cable entrance P are factory plugged

23.3 Cable glands and threaded plug for SF - see tech table **KX800**

Communication interfaces	To be ordered separately				Cable entrance overview	Notes
	Cable gland quantity	Cable gland entrance	Threaded plug quantity	Threaded plug entrance		
NP	4	D1 D2 A - E	none	none		Cable entrance A, E, D1, D2 are open for costumers Cable entrance P are factory plugged
BC, BP, EH, EW, EI, EP "via stub" connection	5	D1 - D2 C1 A - E	1	C2		Cable entrance A, E, C1, C2, D1, D2 are open for costumers
BC, BP, EH, EW, EI, EP "daisy chain" connection	6	D1 - D2 C1 - C2 A - E	none	none		Cable entrance A, E, C1, C2, D1, D2 are open for costumers

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

24.1 External reference and transducer parameters

Allow to configure the controller 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)

24.2 PID control dynamics parameters

Allow to optimize and adapt the controller 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

24.3 Monitoring parameters

Allow to configure the controller 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 24.4)

24.4 Fault parameters

Allow to configure how the controller detects and reacts 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, controller disabling, etc.)

24.5 Valve characteristics compensation

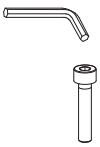
Allow to modify the valve regulation to match the actuator/system characteristics and to obtain the best overall performances:

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

24.6 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).

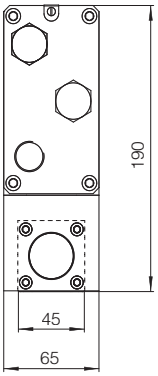
25 FASTENING BOLTS AND SEALS

	DLHZA	DLKZA
	**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)

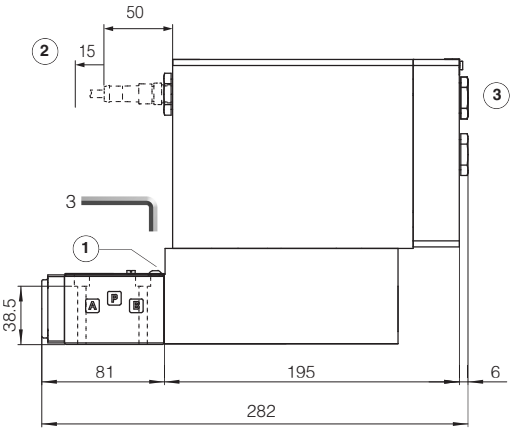
DLHZA-TEZ

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

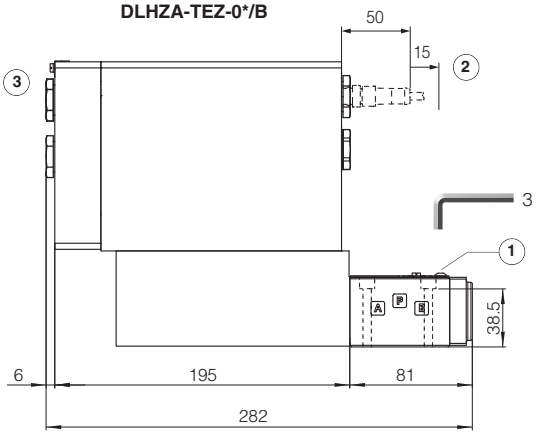
Mass [kg]	
DLHZA-TEZ	7,2



DLHZA-TEZ-0*



DLHZA-TEZ-0*/B



(1) = Air bleed off

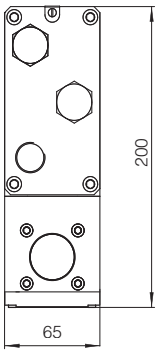
(2) = Space to remove the USB connector

(3) = The dimensions of cable glands must be considered (see tech table **KX800**)

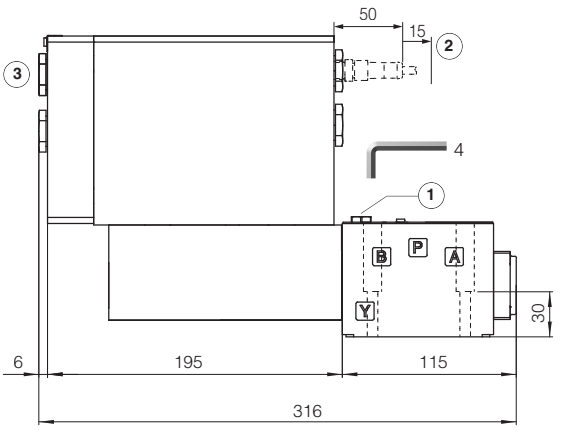
DLKZA-TEZ

ISO 4401: 2000
Mounting surface: 4401-05-04-0-05 (see table P005)
(for /Y surface 4401-05-05-0-05 without X port)

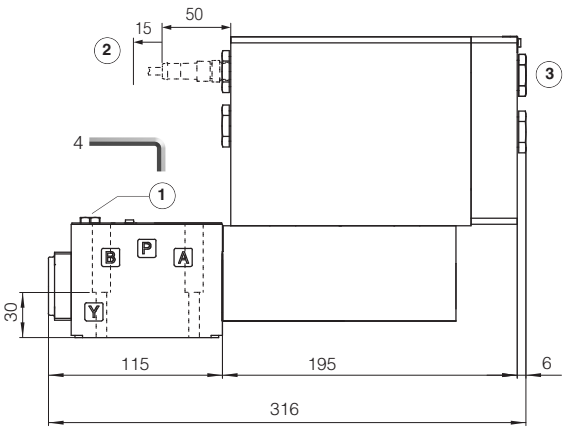
Mass [kg]	
DLKZA-TEZ	9



DLKZA-TEZ-1*



DLKZA-TEZ-1*/B



(1) = Air bleed off

(2) = Space to remove the USB connector

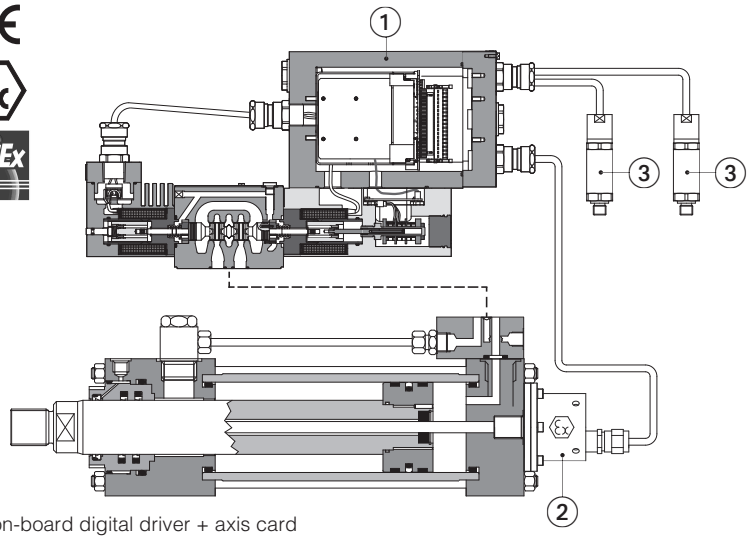
(3) = The dimensions of cable glands must be considered (see tech table **KX800**)

27 RELATED DOCUMENTATION

X010	Basics for electrohydraulics in hazardous environments	**GS510**	Fieldbus
X020	Summary of Atos ex-proof components certified to ATEX, IECEx, EAC, PESO	**GX800**	Ex-proof pressure transducer type E-ATRA-7
FX900	Operating and manintenance information for ex-proof proportional valves	**KX800**	Cable glands for ex-proof valves
GS500	Programming tools	**P005**	Mounting surfaces for electrohydraulic valves

Ex-proof digital servoproportionals with on-board axis card

direct, with LVDT transducer and zero spool overlap - **ATEX and IECEx**



① on-board digital driver + axis card
② transducer to feedback the axis position
③ pressure/force transducers

DKZA-TEZ-D-SF-NP-170*

DHZA-TEZ, DKZA-TEZ

Ex-proof digital servoproportional valves equipped with on-board driver plus axis card, LVDT position transducer and zero spool overlap to perform the position control of any linear or rotative hydraulic actuator.

They are certified for safe operations in hazardous environments with potentially explosive atmosphere.

- Multicertification **ATEX** and **IECEx** for gas group **II 2G** and dust category **II 2D**

The controlled actuator has to be equipped with integral or external ex-proof transducer (analog, potentiometer, SSI or Encoder) to feedback the axis position.

The valve can be operated by an external or internally generated reference position signal, see section 2.

Options SF, SL add the alternated pressure/force control to the basic position one, see section 3.

DHZA:
Size: **06** -ISO 4401
Max flow: **60 l/min**
Max pressure: **350 bar**

DKZA:
Size: **10** -ISO 4401
Max flow: **150 l/min**
Max pressure: **315 bar**

1 MODEL CODE

DHZA	-	TEZ	-	D	-	SN	-	NP	-	0	70	-	L	5	/	M	/	*	*	/	*

Ex-proof servoproportional directional valves, direct
DHZA = size 06
DKZA = 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 tranducers)
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**

70 =

Spool size:

	3 (L)	**5** (L,D)
DHZA =	18	28
DKZA =	45	75

Nominal flow (l/min) at Δp 10 bar 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

Seals material, see section 9:
- = NBR
PE = FKM
BT = HNBR

Series number

Hydraulic options (1):
B = solenoid with integral digital electronics at side of port A **(2)**
Y = external drain

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

Cable entrance threaded connection:
M = M20x1,5

(1) For possible combined options, see section 15
(2) In standard configuration the solenoid with on-board digital driver and position transducer are at side port B

2 POSITION REFERENCE MODE

2.1 External reference generation

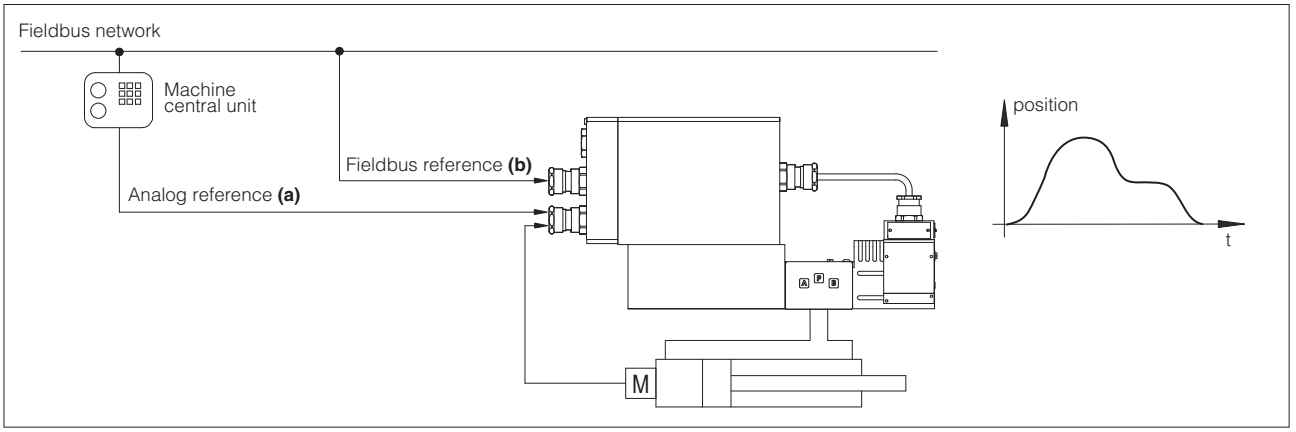
Axis controller regulates in closed loop the actuator position according to an external reference position signal and to the position feedback from the actuator transducer.

The external reference signal can be software selected among:

Analog reference (a) - the controller receives in real time the reference signal from the machine electronic central unit by means analog input on the terminal board.

Fieldbus reference (b) - the controller receives in real time the reference signal from the machine electronic central unit by means digital fieldbus communication.

For fieldbus communication details, please refer to the controller user manual.



2.2 Internal reference generation

Axis controller regulates in closed loop the actuator position according to an internally generated reference position signal and to the position feedback from the actuator transducer.

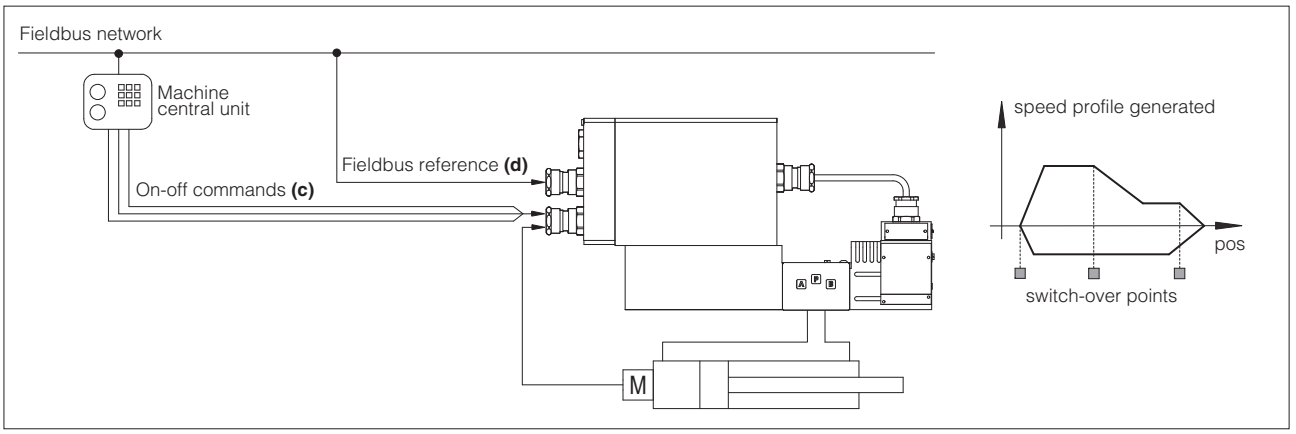
The internal reference signal is generated by a pre-programmed cycle; only start, stop and switch-over commands are required from the machine electronic central unit by means :

- on-off commands ***(c)***

- fieldbus commands ***(d)***

Atos PC software allows to design a customized sequence of motion phases adapted to the specific application requirements: a range of predefined standard sequences are available in the Z-SW software.

Start/stop/switch-over commands and reference generation type can be set for each phase in order to realize an automatic cycle according to the application requests. Refer to the controller user manual for further details on commands and reference generation type.



Start / stop / switch-over commands examples

External digital input	on-off commands, on terminal board, are used to start/stop the cycle generation or to change the motion phase
External fieldbus input	on-off commands, by fieldbus communication, are used to start/stop the cycle generation or to change the motion phase
Switch by position	switch-over from actual to following motion phase occurs when the actual position reaches a programmed value
Switch by time	switch-over from actual to following motion phase occurs after a fixed time, starting from the actual phase activation

Reference generation types examples

Absolute	a target position reference signal is internally generated for each motion phase; maximum speed and acceleration can be set to obtain a smooth and precise position control
Relative	as 'Absolute' but the target position corresponds to the actuator position plus a fixed quote internally set by software
Time	as 'Absolute' type but the controller automatically determines the speed and acceleration in order to reach the target absolute position in the fixed time internally set by software

3 ALTERNATED POSITION / FORCE CONTROL

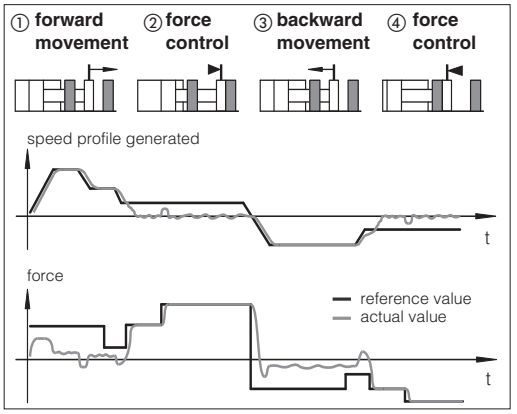
SF and **SL** options add the alternated force closed loop control to the actuator standard position control. Pressure or force remote transducers have to be installed on the actuator and interfaced to the valve driver, see below functional schemes.

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.

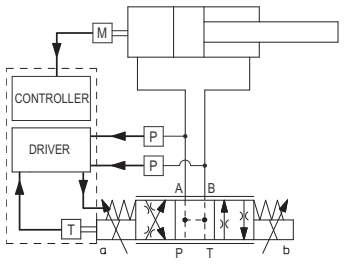
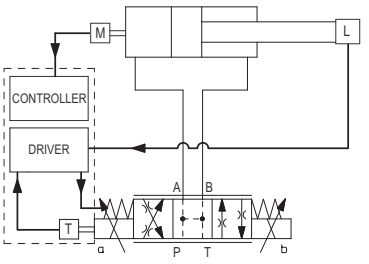
The dynamics of the switching between the two controls can be regulated thanks to specific software setting, in order to avoid instability and vibrations.

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 controller 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 **FX900** and in the user manuals included in the Z-SW-* programming software.

5 VALVE SETTINGS AND PROGRAMMING TOOLS

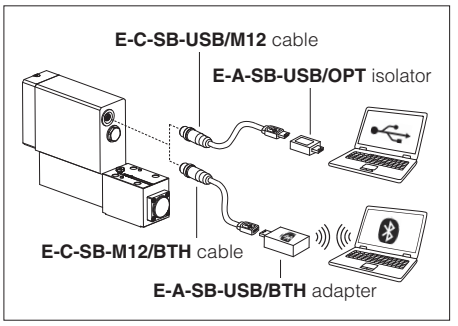
Valve's functional parameters and configurations, can be easily set and optimized using Atos Z-SW programming software connected via USB port to the digital controller (see table **GS003**).
For fieldbus versions, the software permits valve's parameterization through USB port also if the controller is connected to the central machine unit via fieldbus.

Z-SW-FULL support: NP (USB)
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: drivers 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 executions allow to operate the valves through fieldbus or analog signals available on the terminal board.

7 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 - salt spray test (ISO 9227) > 200 h
Compliance	Explosion proof protection, see section 11 -Flame proof enclosure “Ex d” -Dust ignition protection by enclosure “Ex t” RoHs Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006

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

Valve model		**DHZA**			**DKZA**		
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 [l/min]							
[l/min]	at Δp= 10 bar	18	28	28	45	75	75
Δp P-T	at Δp= 30 bar	30	50	50	80	130	130
	max permissible flow	40	60	60	90	150	150
Δp max P-T [bar]		70	50	50	40	40	40
Response time [ms] **(1)**		≤ 18			≤ 25		
Leakage [cm³]		<500 (at P = 100 bar); <1500 (at P = 350 bar)			<800 (at P = 100 bar); <2500 (at P = 315 bar)		
Hysteresis		≤ 0,2 [% of max regulation]					
Repeatability		± 0,1 [% of max regulation]					
Thermal drift		zero point displacement < 1% at ΔT = 40°C					

(1) 0-100% step signal

9 ELECTRICAL CHARACTERISTICS

Power supplies	Nominal : +24 VDC Rectified and filtered : VRMS = 20 ÷ 32 VMAX (ripple max 10 % VPP)			
Max power consumption	35 W			
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-ATRA-7 see tech table **GX800**)			
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 by 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

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

10 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	

⚠ The ignition temperature of the hydraulic fluid must be 50°C higher than the max solenoid surface temperature

(1) Performance limitations in case of flame resistant fluids with water:
-max operating pressure = 210 bar
-max fluid temperature = 50°C

11 CERTIFICATION DATA

Valve type		DHZA, DKZA				
Certifications		Multicertification Group II **ATEX IECEx**				
Solenoid certified code		**OZA-TEZ**				
Type examination certificate **(1)**		• ATEX: TUV IT 18 ATEX 068 X		• IECEx: IECEx TPS 19.0004X		
Method of protection		• ATEX 2014/34/EU Ex II 2G Ex db IIC T6/T5/T4 Gb Ex II 2D Ex tb IIIC T85°C/T100°C/T135°C Db		• IECEx Ex db IIC T6/T5/T4 Gb Ex tb IIIC T85°C/T100°C/T135°C Db		
Temperature class	Single solenoid valve	**T6**	**-**	**T5**	**T4**	**-**
	Double solenoid valve	**-**	**T4**	**-**	**-**	**T3**
Surface temperature		≤ 85 °C	≤ 135 °C	≤ 100 °C	≤ 135 °C	≤ 200 °C
Ambient temperature **(2)**		-40 ÷ +40 °C		-40 ÷ +55 °C	-40 ÷ +70 °C	
Applicable Standards		EN 60079-0	EN 60079-1	EN 60079-31	IEC 60079-0	IEC 60079-1 IEC 60079-31
Cable entrance: threaded connection		**M** = M20x1,5				

(1) The type examinator certificates can be downloaded from

(2) The controller and solenoids are certified for minimum ambient temperature -40°C.
In case the complete valve must withstand with minimum ambient temperature -40°C, select **/BT** in the model code.

⚠ **WARNING: service work performed on the valve by the end users or not qualified personnel invalidates the certification.**

12 CABLE SPECIFICATION AND TEMPERATURE - Power supply and grounding cables have to comply with following characteristics:

Power supply and signals: section of wire = 1,0 mm² **Grounding:** section of external ground wire = 4 mm²

12.1 Cable temperature

The cable must be suitable for the working temperature as specified in the "safety instructions" delivered with the first supply of the products.

Max ambient temperature [°C]	Temperature class	Max surface temperature [°C]	Min. cable temperature [°C]
40 °C	T6	85 °C	80 °C
55 °C	T5	100 °C	90 °C
70 °C	T4	135 °C	110 °C

13 CABLE GLANDS

Cable glands with threaded connections M20x1,5 for standard or armoured cables have to be ordered separately, see tech table **KX800**

Note: a Loctite sealant type 545, should be used on the cable gland entry threads

14 HYDRAULIC OPTIONS

B = Solenoid, integral electronics and position transducer at side of port A of the main stage. For hydraulic configuration vs reference signal, see 17.1

Y = Option /Y is mandatory if the pressure in port T exceeds 210 bar

15 ELECTRONIC OPTIONS

I = It provides 4 ÷ 20 mA current reference 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.
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 = Only for **SF, SL**
Option /C 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.

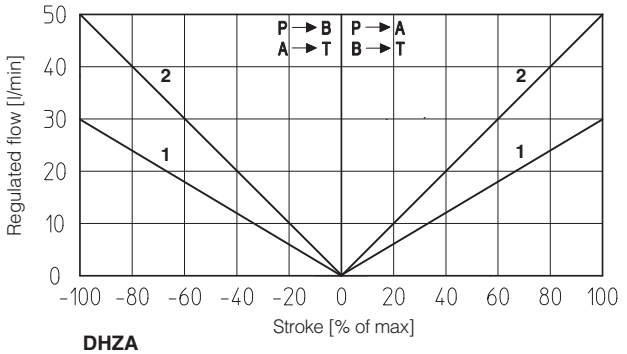
16 POSSIBLE COMBINED OPTIONS

For SN: /BI, /BY, /IY

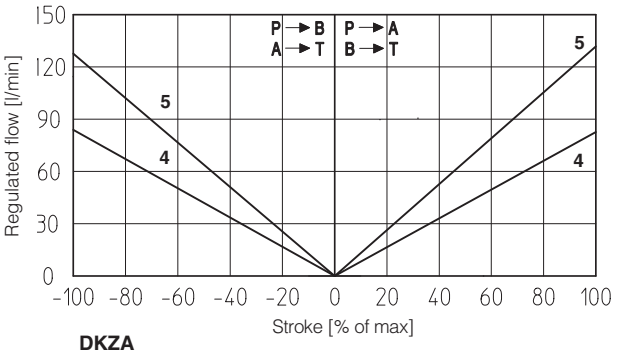
For SF, SL: /BI, /BY, /IY, /CI, /BCI, CIY, BCIY

17 DIAGRAMS - based on mineral oil ISO VG 46 at 50 °C

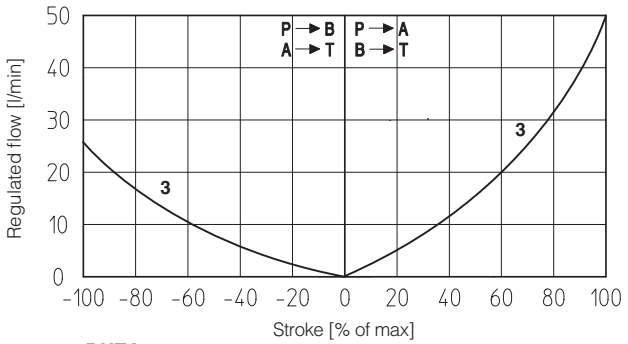
17.1 Regulation diagrams (values measure at Δp 30 bar P-T)



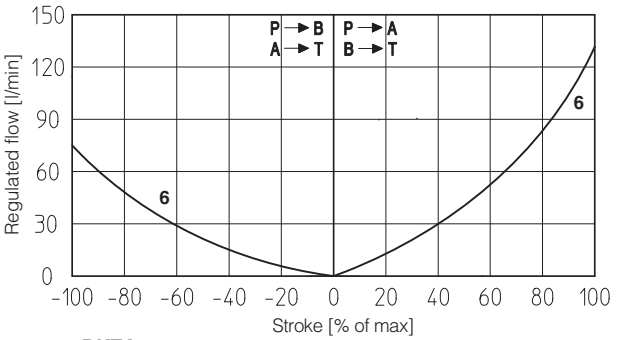
DHZA
1 = L3 **2** = L5



DKZA
4 = L3 **5** = L5



DHZA
3 = D5



DKZA
6 = D5

Note:
Hydraulic configuration vs. reference signal for configurations 71 and 73 (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

18 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, EN-982).

18.1 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: 2,5 A time lag fuse.

18.2 Power supply for driver's logic and communication (VL+ and VL0)

The power supply for controller's logic and communication must be appropriately stabilized or rectified and filtered: apply at least a 10000 μF/40 V capacitance to single phase rectifiers or a 4700 μF/40 V capacitance to three phase rectifiers.
The separate power supply for controller's logic on pin 3 and 4, allow to remove solenoid power supply from pin 1 and 2 maintaining active the diagnostics, USB and fieldbus communications.

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

18.3 Position reference input signal (P_INPUT+)

Functionality of P_INPUT+ signal (pin 10), depends on controller's reference mode, see section 2 :

External analog reference generation (see 2.1): input is used as reference for the controller axis position 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.

Fieldbus/internal reference generation (see 2.2)*:* analog reference input signal can be used as on-off commands with input range 0 ÷ 24VDC.

18.4 Pressure or force reference input signal (F_INPUT+) - only for **SF**, **SL**

Functionality of F_INPUT+ signal (pin 12), depends on selected controllers' reference mode and alternated control options, see section 3 :

SF, SL controls and external analog reference selected : input is used as reference for the controller pressure/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/internal reference selected: analog reference input signal can be used as on-off commands with input range 0 ÷ 24VDC.

18.5 Position monitor output signal (P_MONITOR)

The controller generates an analog output signal (pin 9) proportional to the actual axis position; the monitor output signal can be software set to show other signals available in the controller (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.

18.6 Pressure or force monitor output signal (F_MONITOR) - only for **SF**, **SL**

The controller generates an analog output signal (pin 11) according to alternated pressure/force control option:

SN control: output signal is proportional to the actual valve spool position

SF, SL 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 controller (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.

18.7 Enable input signal (ENABLE)

To enable the controller, a 24VDC voltage has to be applied on pin 6.
When the Enable signal is set to zero the controller 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)

18.8 Fault output signal (FAULT)

Fault output signal indicates fault conditions of the controller (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.

18.9 Position transducer input signal

A position transducer must be always directly connected to the controller. Select the correct controller 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 19.1).

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

Analog remote pressure transducers or load cell can be directly connected to the controller.
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 19.2).

19 ACTUATOR'S TRANSDUCER CHARACTERISTICS

19.1 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.

19.2 Pressure/force transducers

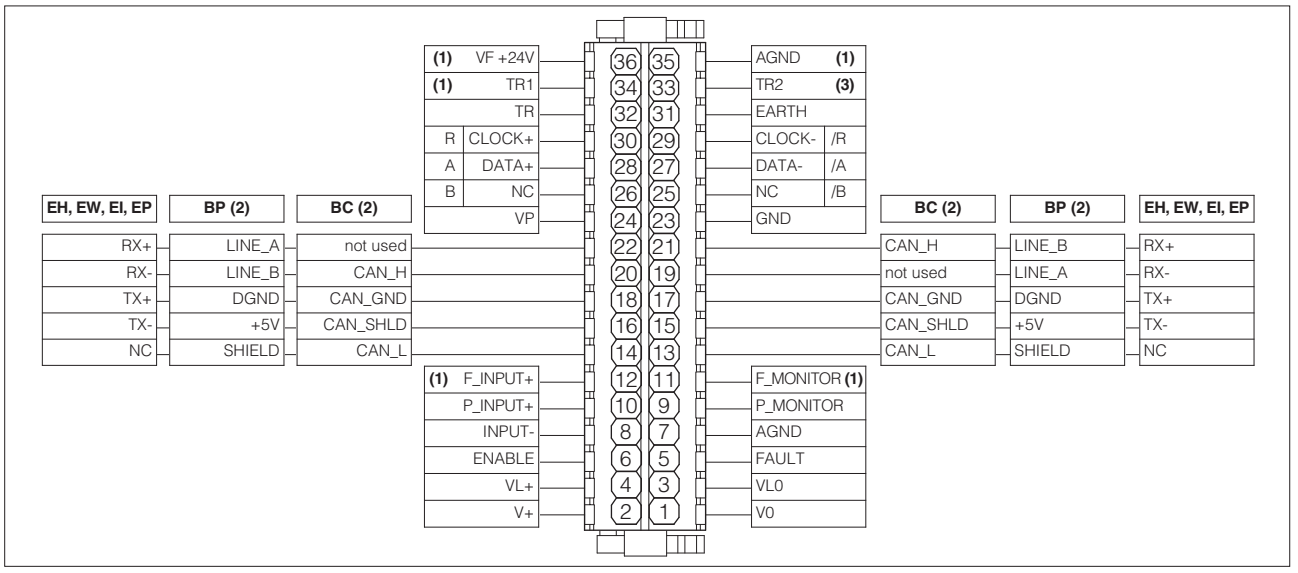
The accuracy of the pressure/force control is strongly dependent to the selected pressure/force transducer, see section 3 .
Alternated pressure/force controls require to install pressure transducers or load cell to measure the actual pressure/force values.
Pressure transducers allow easy system integration and cost effective solution for both alternated position/pressure and position/force controls (see tech table **GX800** 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.

19.3 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 Atos controller **(2)** Percentage of total stroke **(3)** For Balluff BTL7 with SSI interface only special code SA433 is supported

20 TERMINAL BOARD OVERVIEW



(1) Connections available only for **SF**, **SL**
(2) For BC and BP executions the fieldbus connections have an internal pass-through connection
(3) Connection available only for **SF**

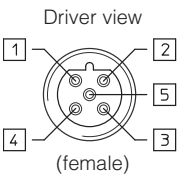
21 ELECTRONIC CONNECTIONS

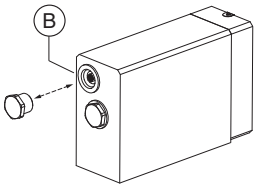
21.1 Main connections signals

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
A	1	**V0**	Power supply 0 VDC	Gnd - power supply
	2	**V+**	Power supply 24 VDC	Input - power supply
	3	**VL0**	Power supply 0 VDC for driver's logic and communication	Gnd - power supply
	4	**VL+**	Power supply 24 VDC for driver's logic and communication	Input - power supply
	5	**FAULT**	Fault (0 VDC) or normal working (24 VDC), referred to VL0	Output - on/off signal
	6	**ENABLE**	Enable (24 VDC) or disable (0 VDC) the driver, referred to VL0	Input - on/off signal
	7	**AGND**	Analog ground	Gnd - analog signal
	8	**INPUT-**	Negative reference input signal for P_INPUT+ and F_INPUT+	Input - analog signal
	9	**P_MONITOR**	Position monitor output signal: ±10 VDC / ±20 mA maximum range, referred to AGND Defaults are: ±10 VDC for standard and 4 ÷ 20 mA for /I option	Output - analog signal **Software selectable**
	10	**P_INPUT+**	Position reference input signal: ±10 VDC / ±20 mA maximum range Defaults are: ±10 VDC for standard and 4 ÷ 20 mA for /I option	Input - analog signal **Software selectable**
	11	**F_MONITOR**	Pressure/Force (SF, SL controls) or valve spool position (SN control) monitor output signal: ±10 VDC / ±20mA maximum range, referred to AGND Defaults are: ±10 VDC for standard and 4 ÷ 20 mA for /I option	Output - analog signal **Software selectable**
	12	**F_INPUT+**	Pressure/Force reference input signal (SF, SL controls): ±10 VDC / ±20 mA max. range Defaults are: ±10 VDC for standard and 4 ÷ 20 mA for /I option	Input - analog signal **Software selectable**
	31	**EARTH**	Internally connected to driver housing	

21.2 USB connector - M12 - 5 pin always present

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
B	1	**+5V_USB**	Power supply
	2	**ID**	Identification
	3	**GND_USB**	Signal zero data line
	4	**D-**	Data line -
	5	**D+**	Data line +





21.3 BC fieldbus execution connections

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
C1	14	**CAN_L**	Bus line (low)
	16	**CAN_SHLD**	Shield
	18	**CAN_GND**	Signal zero data line
	20	**CAN_H**	Bus line (high)
	22	**not used**	Pass-through connection **(1)**

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
C2	13	**CAN_L**	Bus line (low)
	15	**CAN_SHLD**	Shield
	17	**CAN_GND**	Signal zero data line
	19	**not used**	Pass-through connection **(1)**
	21	**CAN_H**	Bus line (high)

(1) Pin 19 and 22 can be fed with external +5V supply of CAN interface

21.4 BP fieldbus execution connections

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
C1	14	**SHIELD**	
	16	**+5V**	Power supply
	18	**DGND**	Data line and termination signal zero
	20	**LINE_B**	Bus line (low)
	22	**LINE_A**	Bus line (high)

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
C2	13	**SHIELD**	
	15	**+5V**	Power supply
	17	**DGND**	Data line and termination signal zero
	19	**LINE_A**	Bus line (high)
	21	**LINE_B**	Bus line (low)

21.5 EH, EW, EI, EP fieldbus execution connections

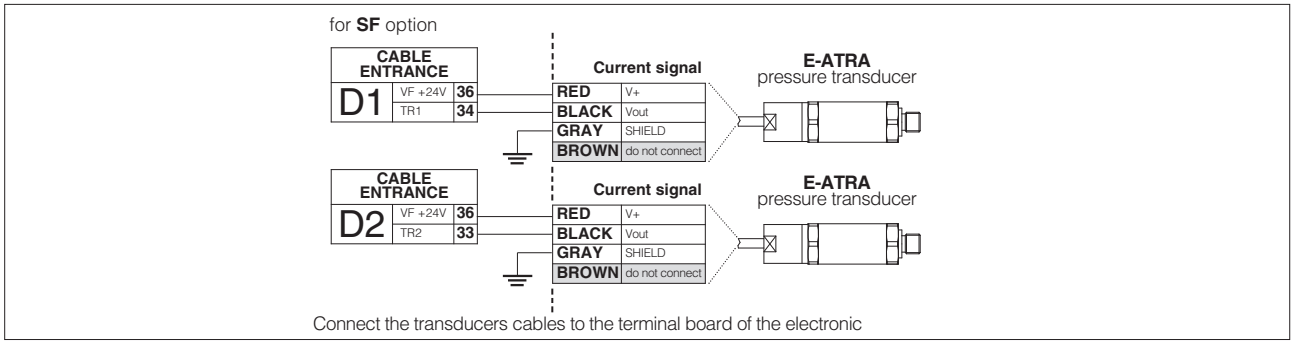
CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
C1 (input)	14	**NC**	do not connect
	16	**TX-**	Transmitter
	18	**TX+**	Transmitter
	20	**RX-**	Receiver
	22	**RX+**	Receiver

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
C2 (output)	13	**NC**	do not connect
	15	**TX-**	Transmitter
	17	**TX+**	Transmitter
	19	**RX-**	Receiver
	21	**RX+**	Receiver

21.6 Remote pressure transducer connections - only for **SF**, **SL**

CABLE ENTRANCES	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES	SL - Single transducer (1)		SF - Double transducers (1)	
					Voltage	Current	Voltage	Current
D1 D2	33	**TR2**	2nd signal transducer ±10 VDC / ±20 mA maximum range	Input - analog signal **Software selectable**	/	/	Connect	Connect
	34	**TR1**	1st signal transducer ±10 VDC / ±20 mA maximum range	Input - analog signal **Software selectable**	Connect	Connect	Connect	Connect
	35	**AGND**	Common gnd for transducer power and signals	Common gnd	Connect	/	Connect	/
	36	**VF +24V**	Power supply +24VDC	Output - power supply	Connect	Connect	Connect	Connect

E-ATRA remote pressure transducer connection - see tech table **GX800**

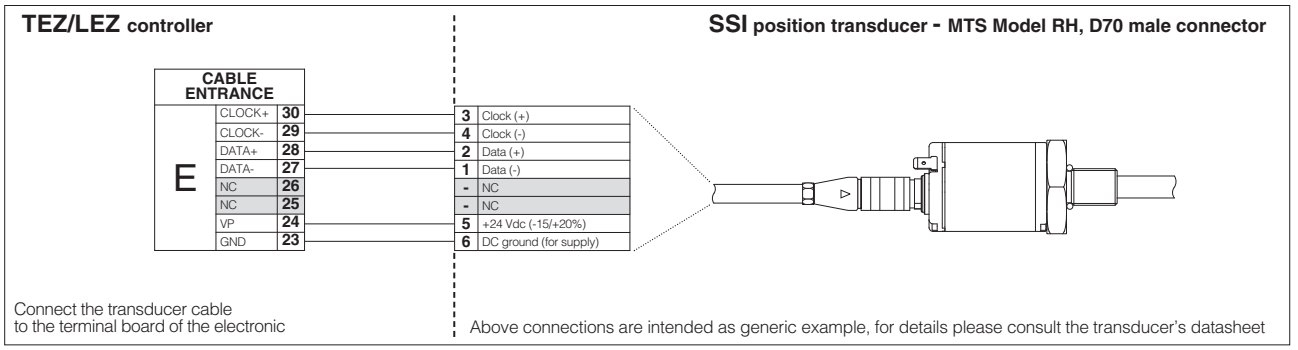


21.7 D execution - Digital position transducers connections

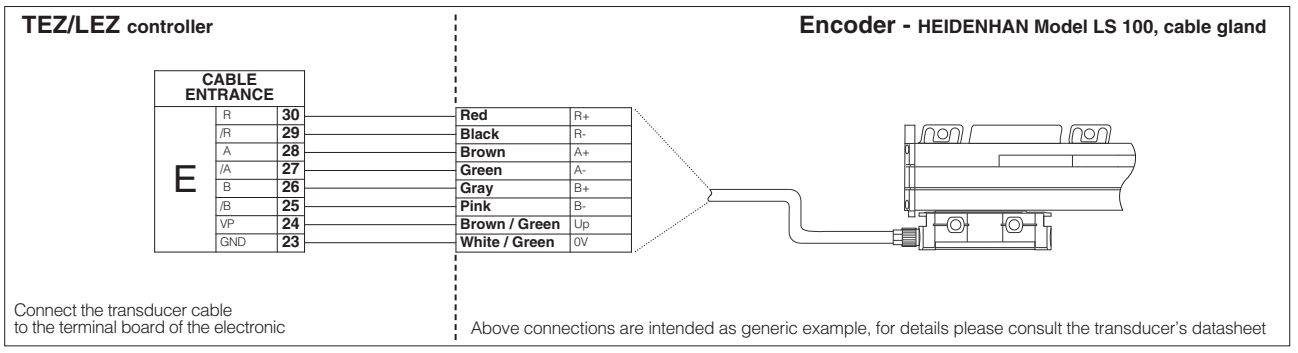
CABLE ENTRANCE	PIN	SSI - default transducer (1)			Encoder (1)		
		SIGNAL	TECHNICAL SPECIFICATION	NOTES	SIGNAL	TECHNICAL SPECIFICATION	NOTES
E	30	**CLOCK+**	Serial syncronous clock (+)	Input - digital signal	**R**	Input channel R	Input - digital signal
	29	**CLOCK-**	Serial syncronous clock (-)		**/R**	Input channel /R	
	28	**DATA+**	Serial position data (+)		**A**	Input channel A	
	27	**DATA-**	Serial position data (-)		**/A**	Input channel /A	
	26	**NC**	Not connect	Do not connect	**B**	Input channel B	
	25	**NC**			**/B**	Input channel /B	
	24	**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**
	23	**GND**	Common gnd for transducer powerand signals	Common gnd	**GND**	Common gnd for transducer power and signals	Common gnd

(1) Digital position transducer type is software selectable: Encoder or SSI, see 18.9

SSI connection - example



Encoder connection - example



21.8 A execution - Analog position transducers connector

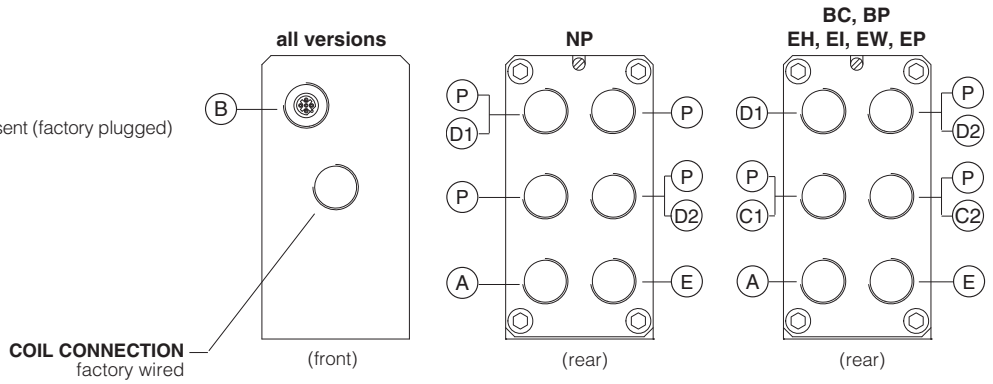
CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATION	NOTES
E	32	**TR**	Signal transducer	Input - analog signal
	24	**VP**	Power supply: +24VDC or OFF (default OFF)	Output - power supply **Software selectable**
	23	**GND**	Common gnd for transducer power and signals	Common gnd

22 CONNECTIONS LAYOUT

CABLE ENTRANCE OVERVIEW

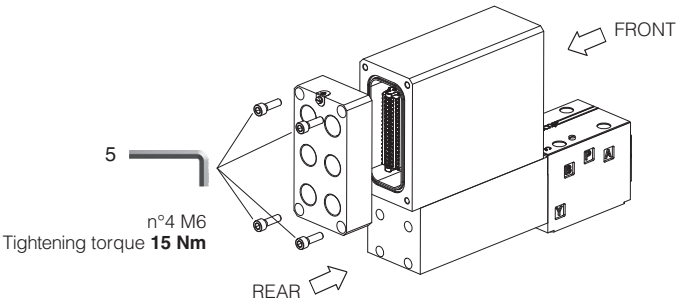
Cables entrance description:

- (A) main connections
- (B) USB connector always present (factory plugged)
- (C1) fieldbus (input)
- (C2) fieldbus (output)
- (D1) pressure transducer 1
- (D2) pressure transducer 2
- (E) position transducer
- (P) threaded plug



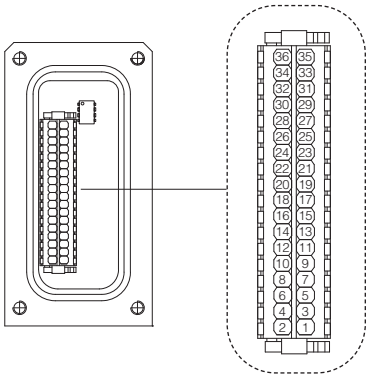
TERMINAL BOARD AND FIELDBUS TERMINATOR

Remove the 4 screws of driver's rear cover to access terminal board and fieldbus terminator

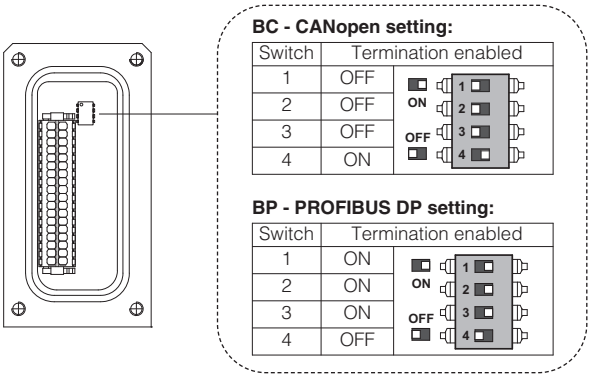


⚠ **WARNING:** the above operation must be performed in a safety area

Terminal board - see section 20



Fieldbus terminator only for BC and BP executions **(1)**



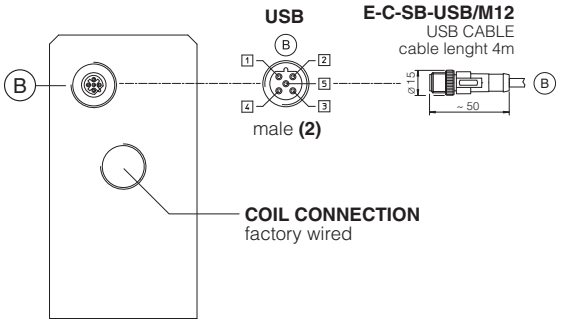
BC - CANopen setting:

Switch	Termination enabled
1	OFF
2	OFF
3	OFF
4	ON

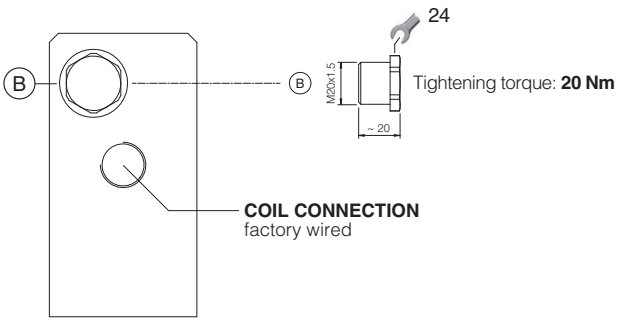
BP - PROFIBUS DP setting:

Switch	Termination enabled
1	ON
2	ON
3	ON
4	OFF

USB CONNECTOR

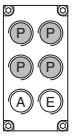
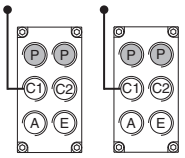
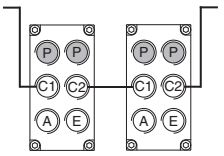


METALLIC PROTECTION CAP - supplied with the valves

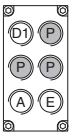
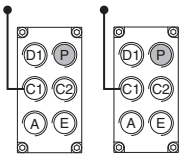
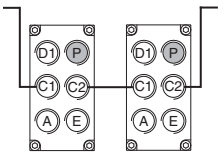


(1) Drivers with BC and BP fieldbus interface are delivered by default 'Not Terminated'. All switches are set OFF
(2) Pin layout always referred to driver's view

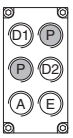
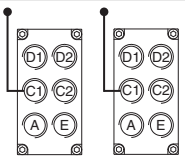
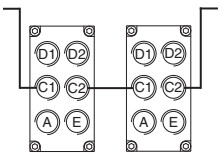
22.1 Cable glands and threaded plug for SN - see tech table **KX800**

Communication interfaces	To be ordered separately				Cable entrance overview	Notes
	Cable gland quantity	entrance	Threaded plug quantity	entrance		
NP	2	A - E	none	none		Cable entrance A, E are open for costumers Cable entrance P are factory plugged
BC, BP, EH, EW, EI, EP "via stub" connection	3	C1 A - E	1	C2		Cable entrance A, E, C1, C2 are open for costumers Cable entrance P are factory plugged
BC, BP, EH, EW, EI, EP "daisy chain" connection	4	C1 - C2 A - E	none	none		Cable entrance A, E, C1, C2 are open for costumers Cable entrance P are factory plugged

22.2 Cable glands and threaded plug for SL - see tech table **KX800**

Communication interfaces	To be ordered separately				Cable entrance overview	Notes
	Cable gland quantity	entrance	Threaded plug quantity	entrance		
NP	3	D1 A - E	none	none		Cable entrance A, E, D1 are open for costumers Cable entrance P are factory plugged
BC, BP, EH, EW, EI, EP "via stub" connection	4	D1 C1 A - E	1	C2		Cable entrance A, E, C1, C2, D1 are open for costumers Cable entrance P are factory plugged
BC, BP, EH, EW, EI, EP "daisy chain" connection	5	D1 C1 - C2 A - E	none	none		Cable entrance A, E, C1, C2, D1 are open for costumers Cable entrance P are factory plugged

22.3 Cable glands and threaded plug for SF - see tech table **KX800**

Communication interfaces	To be ordered separately				Cable entrance overview	Notes
	Cable gland quantity	entrance	Threaded plug quantity	entrance		
NP	4	D1 D2 A - E	none	none		Cable entrance A, E, D1, D2 are open for costumers Cable entrance P are factory plugged
BC, BP, EH, EW, EI, EP "via stub" connection	5	D1 - D2 C1 A - E	1	C2		Cable entrance A, E, C1, C2, D1, D2 are open for costumers
BC, BP, EH, EW, EI, EP "daisy chain" connection	6	D1 - D2 C1 - C2 A - E	none	none		Cable entrance A, E, C1, C2, D1, D2 are open for costumers

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

23.1 External reference and transducer parameters

Allow to configure the controller 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)

23.2 PID control dynamics parameters

Allow to optimize and adapt the controller 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

23.3 Monitoring parameters

Allow to configure the controller 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 23.4)

23.4 Fault parameters

Allow to configure how the controller detects and reacts 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, controller disabling, etc.)

23.5 Valve characteristics compensation

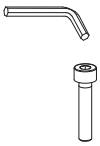
Allow to modify the valve regulation to match the actuator/system characteristics and to obtain the best overall performances:

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

23.6 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).

24 FASTENING BOLTS AND SEALS

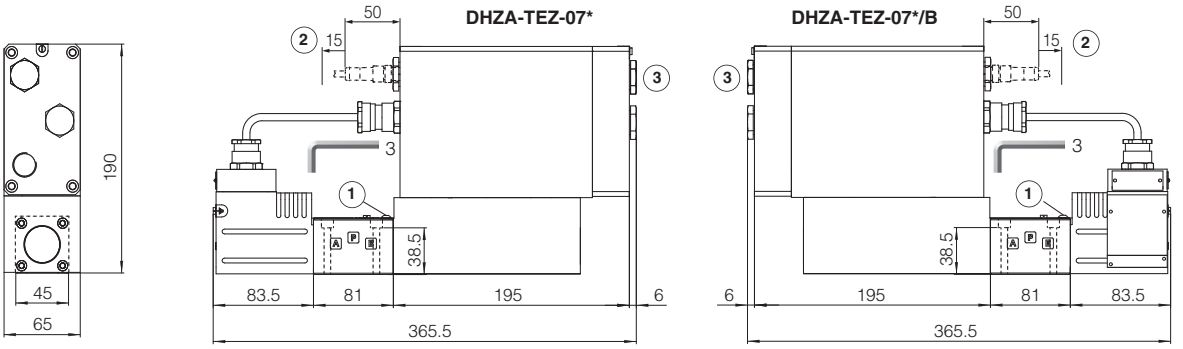
	DHZA	**DKZA**
	**Fastening bolts:** 4 socket head screws M5x50 class 12.9 Tightening torque = 8 Nm	**Fastening bolts:** 4 socket head screws M6x40 class 12.9 Tightening torque = 15 Nm
	**Seals:** 4 OR 108; Diameter of ports A, B, P, T: Ø 7,5 mm (max) 1 OR 2025 Diameter of port Y: Ø = 3,2 mm (only for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

25 INSTALLATION DIMENSIONS [mm]

DHZA-TEZ

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

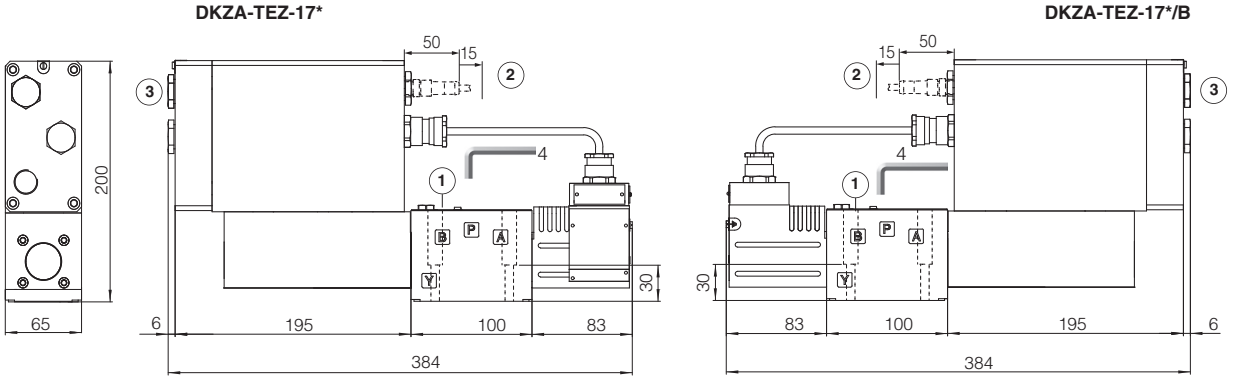
Mass [kg]	
DHZA-TEZ-07	8,9



DKZA-TEZ

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

Mass [kg]	
DKZA-TEZ-17	10,7



(1) = Air bleed off

(2) = Space to remove the USB connector

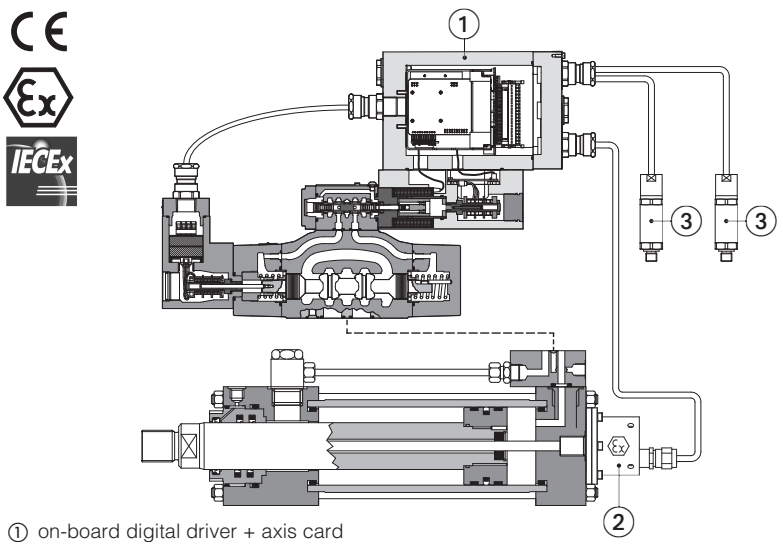
(3) = The dimensions of cable glands must be considered (see tech table **KX800**)

26 RELATED DOCUMENTATION

X010	Basics for electrohydraulics in hazardous environments
X020	Summary of Atos ex-proof components certified to ATEX, IECEx, EAC, PESO
FX900	Operating and manintenance information for ex-proof proportional valves
GS500	Programming tools
GS510	Fieldbus
GX800	Ex-proof pressure transducer type E-ATRA-7
KX800	Cable glands for ex-proof valves
P005	Mounting surfaces for electrohydraulic valves

Ex-proof digital servoproportionals with on-board axis card

piloted, with two LVDT transducers and zero spool overlap - **ATEX and IECEx**



① on-board digital driver + axis card
② transducer to feedback the axis position
③ pressure/force transducers

DPZA-LEZ-D-SF-NP-27*

DPZA-LEZ

Ex-proof digital servoproportional valves equipped with on-board driver plus axis card, two LVDT position transducers (pilot valve and main stage) and zero spool overlap to perform the position control of any linear or rotative hydraulic actuator.

They are certified for safe operations in hazardous environments with potentially explosive atmosphere.

- Multicertification **ATEX** and **IECEx** for gas group **II 2G** and dust category **II 2D**

The controlled actuator has to be equipped with integral or external ex-proof transducer (analog, potentiometer, SSI or Encoder) to feedback the axis position.

The valve can be operated by an external or internally generated reference position signal, see section 2.

Options SF, SL add the alternated pressure/force control to the basic position one, see section 3.

Size: **10** ÷ **27** ISO 4401
Max flow: **180** ÷ **800 l/min**
Max pressure: **350 bar**

1 MODEL CODE

DPZA	- LEZ	- D	- SN	- NP	- 2	70	- L	5	/ M	/ *	*	/ *

DPZA: Ex-proof servoproportional directional valve, piloted

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

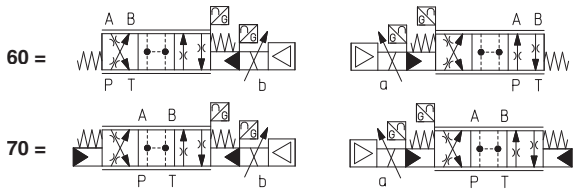
Position transducer type:
A = Analog (standard, potentiometer)
D = Digital (SSI, Encoder)

Alternated P/Q controls:
SN = none
SF = force control (2 pressure tranducers)
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

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



Spool type, regulating characteristics:

L = linear **T** = non linear **(2)**

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

Spool size:

	3 (L)	5 (L,DL)	5 (T)
DPZA-1 =	-	100	-
DPZA-2 =	130	200	150
DPZA-4 =	-	340	-
DPZA-4M =	-	390	-

Nominal flow (l/min) at Δp 10bar P-T

Cable entrance threaded connection:
M = M20x1,5

Hydraulic options (3):
B = solenoid at side of port A **(1)**
D = internal drain
E = external pilot pressure
G = pressure reducing valve for piloting (standard for size 10)

Electronic options (3):
C = current feedback for pressure transducer 4÷20 mA, only for **SF, SL** (omit for std voltage ±10 VDC)
I = current reference input and monitor 4÷20mA (omit for std voltage ±10VDC)

Series number

Seals material, see section 10 :
- = NBR
PE = FKM
BT = HNBR

(1) In standard configuration the solenoid with on-board digital driver and position transducer are at side A of main stage (side B of pilot valve)
(2) Only for configuration 70
(3) For possible combined options consult Atos technical office

2 POSITION REFERENCE MODE

2.1 External reference generation

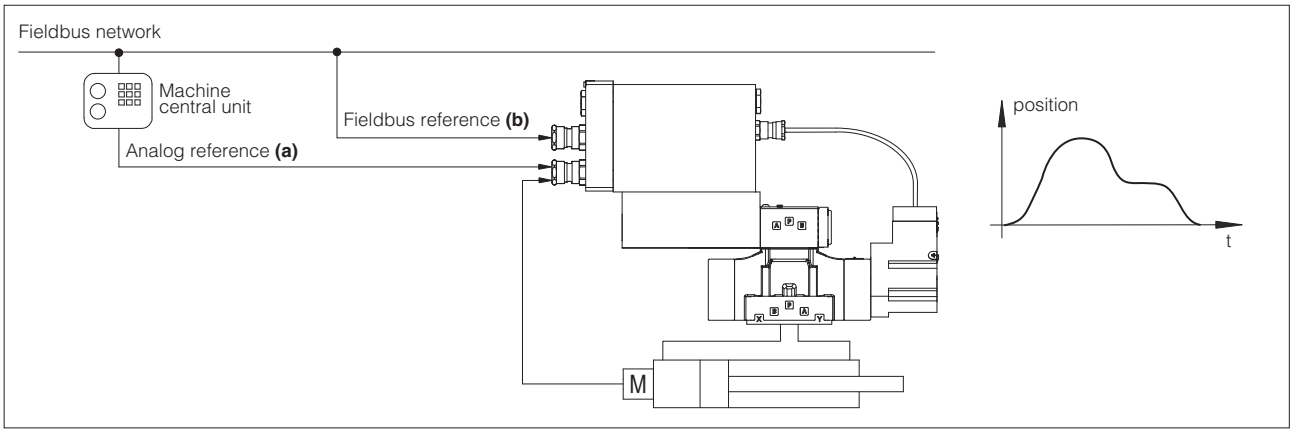
Axis controller regulates in closed loop the actuator position according to an external reference position signal and to the position feedback from the actuator transducer.

The external reference signal can be software selected among:

Analog reference (a) - the controller receives in real time the reference signal from the machine electronic central unit by means analog input on the terminal board.

Fieldbus reference (b) - the controller receives in real time the reference signal from the machine electronic central unit by means digital fieldbus communication.

For fieldbus communication details, please refer to the controller user manual.



2.2 Internal reference generation

Axis controller regulates in closed loop the actuator position according to an internally generated reference position signal and to the position feedback from the actuator transducer.

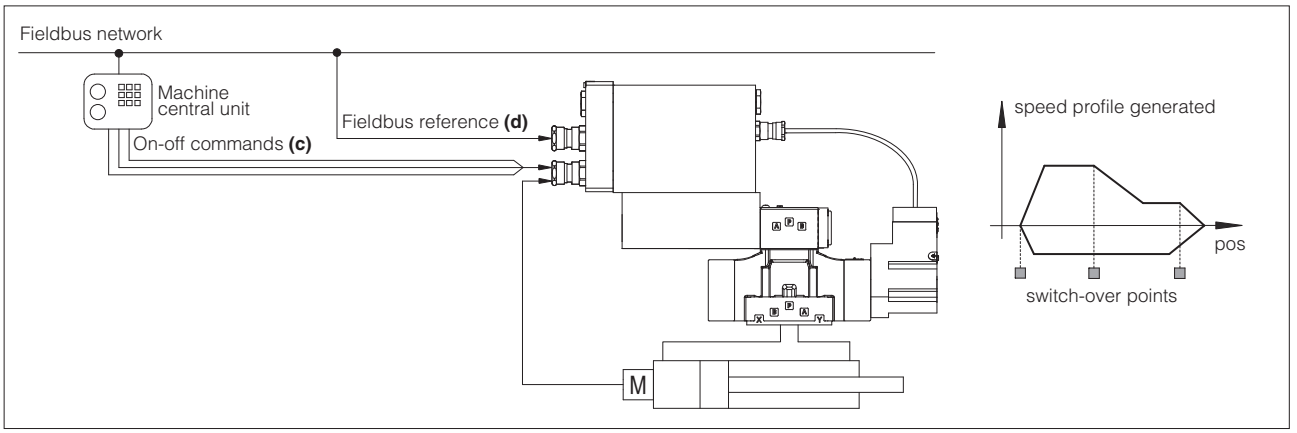
The internal reference signal is generated by a pre-programmed cycle; only start, stop and switch-over commands are required from the machine electronic central unit by means :

*- on-off commands **(c)***

*- fieldbus commands **(d)***

Atos PC software allows to design a customized sequence of motion phases adapted to the specific application requirements: a range of predefined standard sequences are available in the Z-SW software.

Start/stop/switch-over commands and reference generation type can be set for each phase in order to realize an automatic cycle according to the application requests. Refer to the controller user manual for further details on commands and reference generation type.



Start / stop / switch-over commands examples

External digital input	on-off commands, on terminal board, are used to start/stop the cycle generation or to change the motion phase
External fieldbus input	on-off commands, by fieldbus communication, are used to start/stop the cycle generation or to change the motion phase
Switch by position	switch-over from actual to following motion phase occurs when the actual position reaches a programmed value
Switch by time	switch-over from actual to following motion phase occurs after a fixed time, starting from the actual phase activation

Reference generation types examples

Absolute	a target position reference signal is internally generated for each motion phase; maximum speed and acceleration can be set to obtain a smooth and precise position control
Relative	as 'Absolute' but the target position corresponds to the actuator position plus a fixed quote internally set by software
Time	as 'Absolute' type but the controller automatically determines the speed and acceleration in order to reach the target absolute position in the fixed time internally set by software

3 ALTERNATED POSITION / FORCE CONTROL

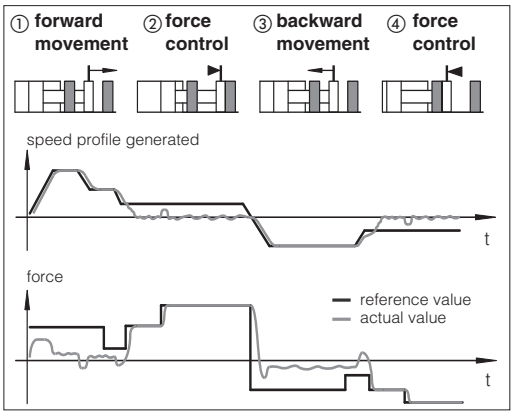
SF and **SL** options add the alternated force closed loop control to the actuator standard position control. Pressure or force remote transducers have to be installed on the actuator and interfaced to the valve driver, see below functional schemes.

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.

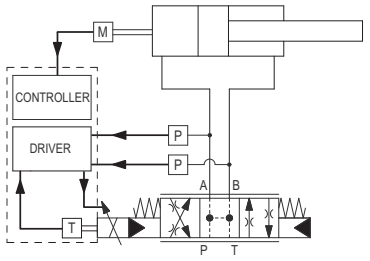
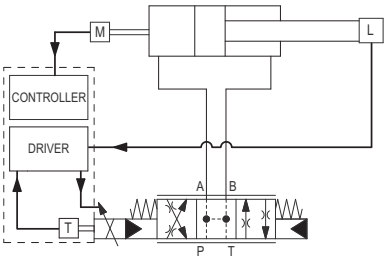
The dynamics of the switching between the two controls can be regulated thanks to specific software setting, in order to avoid instability and vibrations.

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 controller 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 **FX900** and in the user manuals included in the Z-SW-* programming software.

5 VALVE SETTINGS AND PROGRAMMING TOOLS

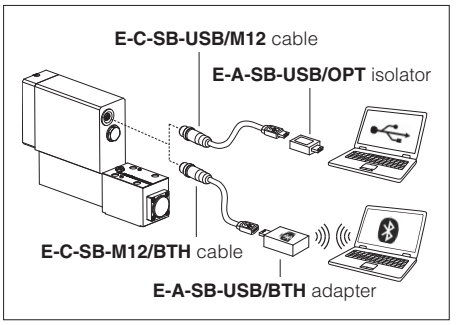
Valve's functional parameters and configurations, can be easily set and optimized using Atos Z-SW programming software connected via USB port to the digital controller (see table **GS003**).
For fieldbus versions, the software permits valve's parameterization through USB port also if the controller is connected to the central machine unit via fieldbus.

Z-SW-FULL support: NP (USB)
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: drivers 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 executions allow to operate the valves through fieldbus or analog signals available on the terminal board.

7 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 - salt spray test (ISO 9227) > 200 h
Compliance	Explosion proof protection, see section 11 -Flame proof enclosure “Ex d” -Dust ignition protection by enclosure “Ex t” RoHs Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006

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

Valve model		**DPZA-*-1**	**DPZA-*-2**			**DPZA-*-4**	**DPZA-*-4M**
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**	
Nominal flow [l/min]							
Δp P-T	Δp = 10 bar	100	130	200	150	340	390
	Δp = 30 bar	160	220	350	260	590	670
	Max permissible flow	180	320	440	360	680	800
Δp max P-T	[bar]	50	60	60	60	60	60
Piloting pressure	[bar]	min. = 25; max = 350 (option /G advisable for pilot pressure > 200 bar)					
Piloting volume	[cm³]	1,4	3,7			9,0	11,3
Piloting flow **(1)**	[l/min]	1,7	3,7			6,8	8
Leakage	Pilot [cm³/min]	100/300	150/450			200/600	200/600
(2)	Main stage [l/min]	0,4/1,2	0,6/2,5			1,0/4,0	1,0/4,0
Response time **(1)**	[ms]	≤ 30	≤ 30			≤ 35	≤ 40
Hysteresis		≤ 0,1 [% of max regulation]					
Repeatability		± 0,1 [% of max regulation]					

(1) 0 ÷100 % step signal and pilot pressure 100 bar
(2) at P = 100/350 bar

9 ELECTRICAL CHARACTERISTICS

Power supplies	Nominal : +24 VDC Rectified and filtered : VRMS = 20 ÷ 32 VMAX (ripple max 10 % VPP)			
Max power consumption	35 W			
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-ATRA-7 see tech table **GX800**)			
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 by 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

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

10 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	

⚠ The ignition temperature of the hydraulic fluid must be 50°C higher than the max solenoid surface temperature

(1) Performance limitations in case of flame resistant fluids with water:
-max operating pressure = 210 bar
-max fluid temperature = 50°C

11 CERTIFICATION DATA

Valve type	DPZA				
Certifications	Multicertification Group II **ATEX IECEx**				
Solenoid certified code	**OZA-LEZ**				
Type examination certificate **(1)**	• ATEX: TUV IT 18 ATEX 068 X		• IECEx: IECEx TPS 19.0004X		
Method of protection	• ATEX 2014/34/EU Ex II 2G Ex db IIC T6/T5/T4 Gb Ex II 2D Ex tb IIIC T85°C/T100°C/T135°C Db		• IECEx Ex db IIC T6/T5/T4 Gb Ex tb IIIC T85°C/T100°C/T135°C Db		
Temperature class	**T6**		**T5**		**T4**
Surface temperature	≤ 85 °C		≤ 100 °C		≤ 135 °C
Ambient temperature **(2)**	-40 ÷ +40 °C		-40 ÷ +55 °C		-40 ÷ +70 °C
Applicable Standards	EN 60079-0	EN 60079-1	EN 60079-31	IEC 60079-0	IEC 60079-1	IEC 60079-31
Cable entrance: threaded connection	**M** = M20x1,5				

(1) The type examinator certificates can be downloaded from

(2) The controller and solenoids are certified for minimum ambient temperature -40°C.
In case the complete valve must withstand with minimum ambient temperature -40°C, select **/BT** in the model code.

⚠ **WARNING: service work performed on the valve by the end users or not qualified personnel invalidates the certification.**

12 CABLE SPECIFICATION AND TEMPERATURE - Power supply and grounding cables have to comply with following characteristics:

Power supply and signals: section of wire = 1,0 mm² **Grounding:** section of external ground wire = 4 mm²

12.1 Cable temperature

The cable must be suitable for the working temperature as specified in the "safety instructions" delivered with the first supply of the products.

Max ambient temperature [°C]	Temperature class	Max surface temperature [°C]	Min. cable temperature [°C]
40 °C	T6	85 °C	80 °C
55 °C	T5	100 °C	90 °C
70 °C	T4	135 °C	110 °C

13 CABLE GLANDS

Cable glands with threaded connections M20x1,5 for standard or armoured cables have to be ordered separately, see tech table **KX800**

Note: a Loctite sealant type 545, should be used on the cable gland entry threads

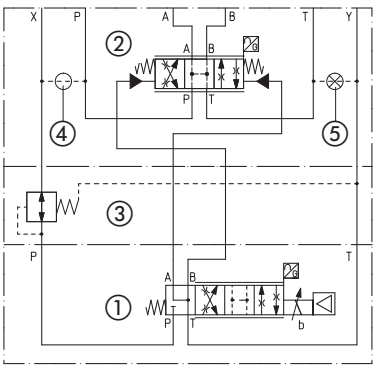
14 HYDRAULIC OPTIONS

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

D and **E** = Pilot and drain configuration can be modified as shown in section 22.
The valve's standard configuration provides internal pilot and external drain.
For different pilot / drain configuration select:
Option /D Internal drain.
Option /E External pilot (through port X).

G = Pressure reducing valve installed between pilot valve and main body with fixed setting:
DPZA-2 = 28 bar
DPZA-2, -4 and -4M = 40 bar
It is advisable for valves with internal pilot in case of system pressure higher than 150 bar.
Pressure reducing valve is standard for DPZA-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

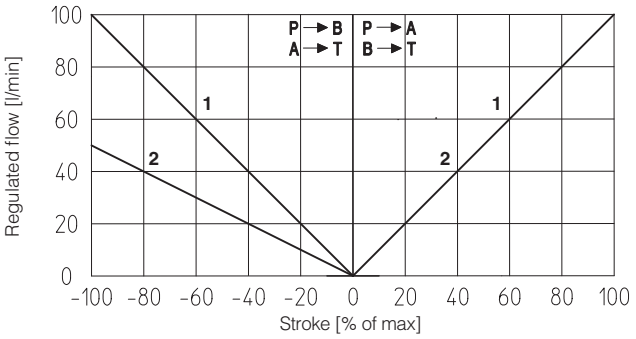
15 ELECTRONIC OPTIONS

I = It provides 4 ÷ 20 mA current reference 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.
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.

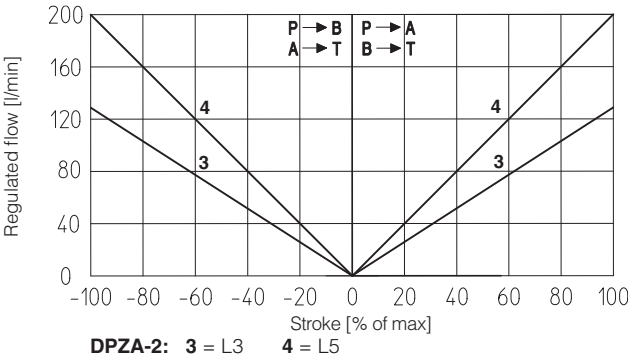
C = Only for **SF, SL**
Option /C is available to connect pressure (force) transducers with 4 ÷ 20 mA current output signal, instead of the standard ±10 VDC.
Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ±20 mA.

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

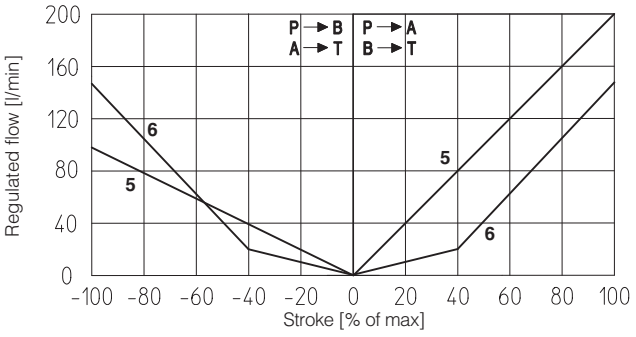
16.1 Regulation diagrams (values measure at Δp 10 bar P-T)



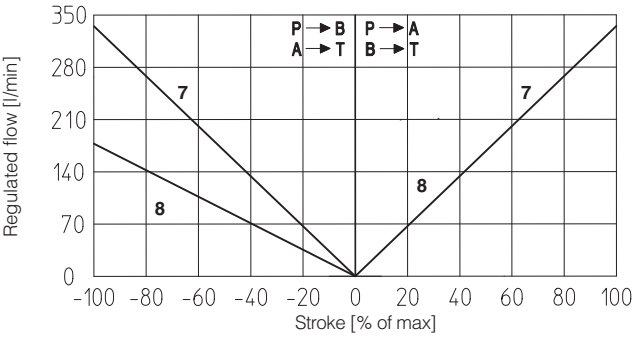
DPZA-1: **1** = L5 **2** = DL5



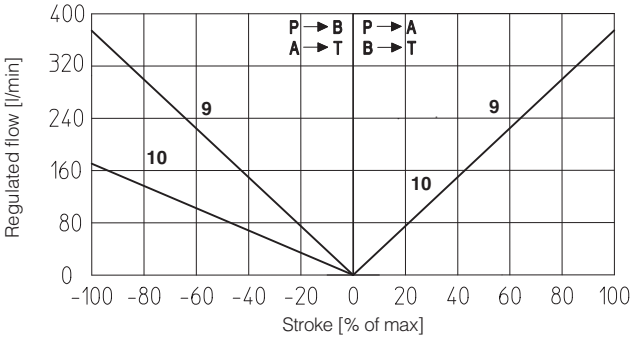
DPZA-2: **3** = L3 **4** = L5



DPZA-2: **5** = DL5 **6** = T5



DPZA-4: **7** = L5 **8** = DL5



DPZA-4M: **9** = L5 **10** = DL5

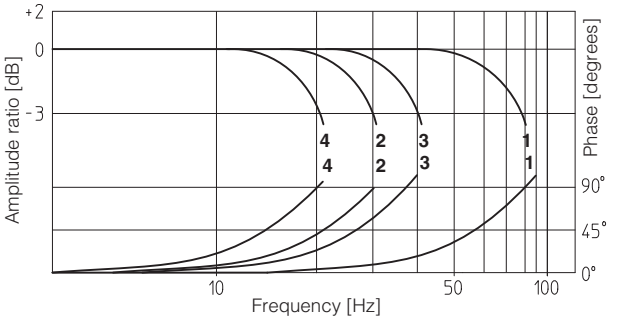
Note: Hydraulic configuration vs. reference signal
for configurations 60 and 70 (standard and option /B)

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

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

16.2 Bode diagrams

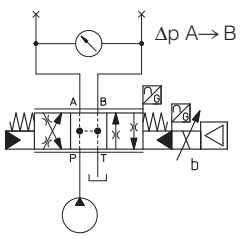
Stated at nominal hydraulic conditions.

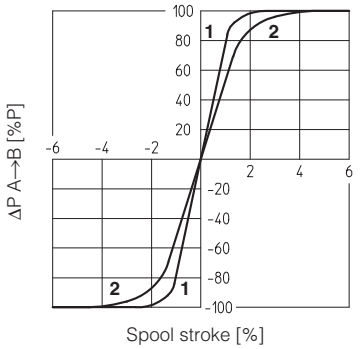


1 = DPZA-1 / DPZA-2 } ± 5% **2** = DPZA-1 / DPZA-2 } ± 100%

3 = DPZA-4 / DPZA-4M } ± 5% **4** = DPZA-4 / DPZA-4M } ± 100%

16.3 Pressure gain





1 = DPZA-1

2 = DPZA-2
DPZA-4
DPZA-4M

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, EN-982).

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.

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

17.2 Power supply for driver's logic and communication (VL+ and VL0)

The power supply for controller's logic and communication must be appropriately stabilized or rectified and filtered: apply at least a 10000 μF/40 V capacitance to single phase rectifiers or a 4700 μF/40 V capacitance to three phase rectifiers.
The separate power supply for controller's logic on pin 3 and 4, allow to remove solenoid power supply from pin 1 and 2 maintaining active the diagnostics, USB and fieldbus communications.

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

17.3 Position reference input signal (P_INPUT+)

Functionality of P_INPUT+ signal (pin 10), depends on controller's reference mode, see section 2 :

External analog reference generation (see 2.1): input is used as reference for the controller axis position 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.

Fieldbus/internal reference generation (see 2.2)*:* analog reference input signal can be used as on-off commands with input range 0 ÷ 24VDC.

17.4 Pressure or force reference input signal (F_INPUT+) - only for **SF**, **SL**

Functionality of F_INPUT+ signal (pin 12), depends on selected controllers' reference mode and alternated control options, see section 3 :

SF, SL controls and external analog reference selected : input is used as reference for the controller pressure/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/internal reference selected: analog reference input signal can be used as on-off commands with input range 0 ÷ 24VDC.

17.5 Position monitor output signal (P_MONITOR)

The controller generates an analog output signal (pin 9) proportional to the actual axis position; the monitor output signal can be software set to show other signals available in the controller (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 Pressure or force monitor output signal (F_MONITOR) - only for **SF**, **SL**

The controller generates an analog output signal (pin 11) according to alternated pressure/force control option:

SN control: output signal is proportional to the actual valve spool position

SF, SL 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 controller (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 controller, a 24VDC voltage has to be applied on pin 6.
When the Enable signal is set to zero the controller 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 controller (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 controller. Select the correct controller 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 controller.
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 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.

18.2 Pressure/force transducers

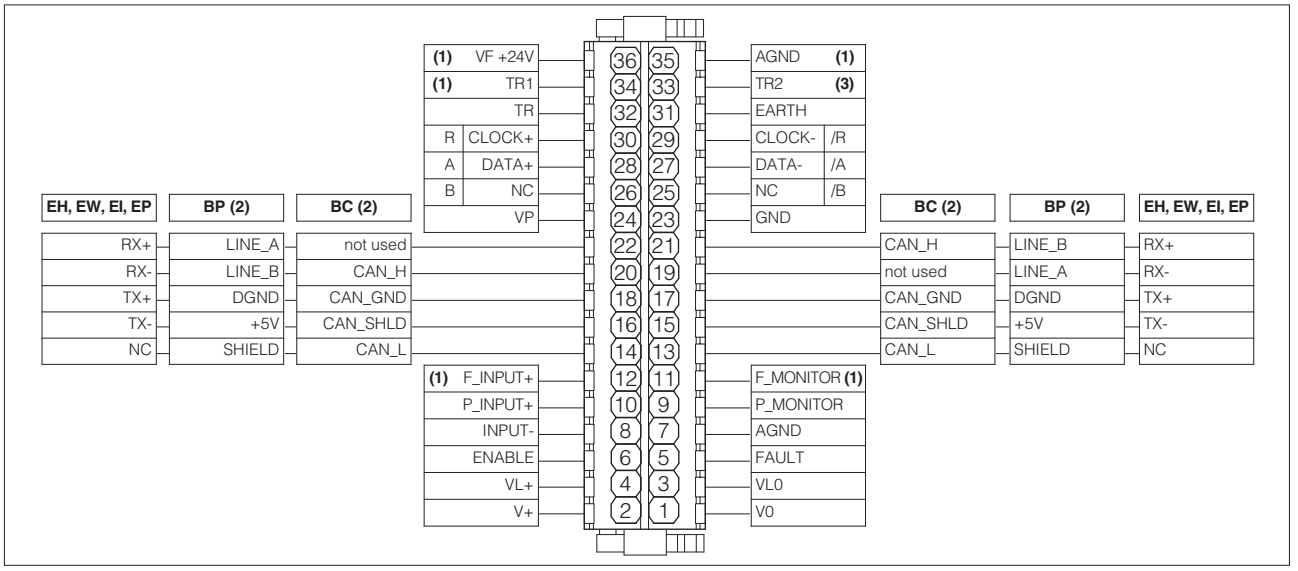
The accuracy of the pressure/force control is strongly dependent to the selected pressure/force transducer, see section 3 .
Alternated pressure/force controls require to install pressure transducers or load cell to measure the actual pressure/force values.
Pressure transducers allow easy system integration and cost effective solution for both alternated position/pressure and position/force controls (see tech table **GX800** 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
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 Atos controller **(2)** Percentage of total stroke **(3)** For Balluff BTL7 with SSI interface only special code SA433 is supported

19 TERMINAL BOARD OVERVIEW



(1) Connections available only for **SF**, **SL**
(2) For BC and BP executions the fieldbus connections have an internal pass-through connection
(3) Connection available only for **SF**

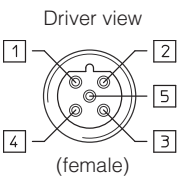
20 ELECTRONIC CONNECTIONS

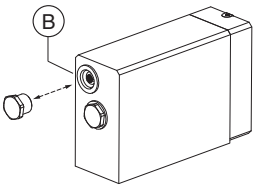
20.1 Main connections signals

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
A	1	**V0**	Power supply 0 VDC	Gnd - power supply
	2	**V+**	Power supply 24 VDC	Input - power supply
	3	**VL0**	Power supply 0 VDC for driver's logic and communication	Gnd - power supply
	4	**VL+**	Power supply 24 VDC for driver's logic and communication	Input - power supply
	5	**FAULT**	Fault (0 VDC) or normal working (24 VDC), referred to VL0	Output - on/off signal
	6	**ENABLE**	Enable (24 VDC) or disable (0 VDC) the driver, referred to VL0	Input - on/off signal
	7	**AGND**	Analog ground	Gnd - analog signal
	8	**INPUT-**	Negative reference input signal for P_INPUT+ and F_INPUT+	Input - analog signal
	9	**P_MONITOR**	Position monitor output signal: ±10 VDC / ±20 mA maximum range, referred to AGND Defaults are: ±10 VDC for standard and 4 ÷ 20 mA for /I option	Output - analog signal **Software selectable**
	10	**P_INPUT+**	Position reference input signal: ±10 VDC / ±20 mA maximum range Defaults are: ±10 VDC for standard and 4 ÷ 20 mA for /I option	Input - analog signal **Software selectable**
	11	**F_MONITOR**	Pressure/Force (SF, SL controls) or valve spool position (SN control) monitor output signal: ±10 VDC / ±20mA maximum range, referred to AGND Defaults are: ±10 VDC for standard and 4 ÷ 20 mA for /I option	Output - analog signal **Software selectable**
	12	**F_INPUT+**	Pressure/Force reference input signal (SF, SL controls): ±10 VDC / ±20 mA max. range Defaults are: ±10 VDC for standard and 4 ÷ 20 mA for /I option	Input - analog signal **Software selectable**
	31	**EARTH**	Internally connected to driver housing	

20.2 USB connector - M12 - 5 pin always present

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
B	1	**+5V_USB**	Power supply
	2	**ID**	Identification
	3	**GND_USB**	Signal zero data line
	4	**D-**	Data line -
	5	**D+**	Data line +





20.3 BC fieldbus execution connections

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
C1	14	**CAN_L**	Bus line (low)
	16	**CAN_SHLD**	Shield
	18	**CAN_GND**	Signal zero data line
	20	**CAN_H**	Bus line (high)
	22	**not used**	Pass-through connection **(1)**

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
C2	13	**CAN_L**	Bus line (low)
	15	**CAN_SHLD**	Shield
	17	**CAN_GND**	Signal zero data line
	19	**not used**	Pass-through connection **(1)**
	21	**CAN_H**	Bus line (high)

(1) Pin 19 and 22 can be fed with external +5V supply of CAN interface

20.4 BP fieldbus execution connections

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
C1	14	**SHIELD**	
	16	**+5V**	Power supply
	18	**DGND**	Data line and termination signal zero
	20	**LINE_B**	Bus line (low)
	22	**LINE_A**	Bus line (high)

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
C2	13	**SHIELD**	
	15	**+5V**	Power supply
	17	**DGND**	Data line and termination signal zero
	19	**LINE_A**	Bus line (high)
	21	**LINE_B**	Bus line (low)

20.5 EH, EW, EI, EP fieldbus execution connections

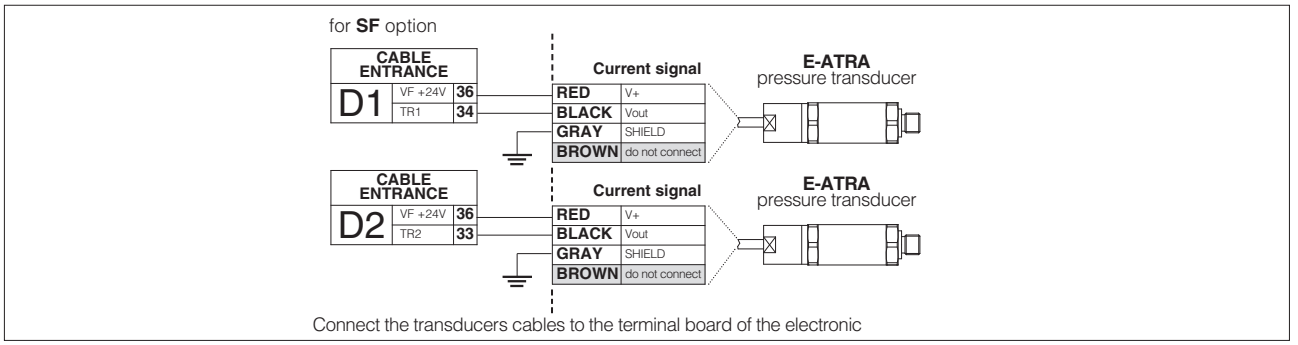
CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
C1 (input)	14	**NC**	do not connect
	16	**TX-**	Transmitter
	18	**TX+**	Transmitter
	20	**RX-**	Receiver
	22	**RX+**	Receiver

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS
C2 (output)	13	**NC**	do not connect
	15	**TX-**	Transmitter
	17	**TX+**	Transmitter
	19	**RX-**	Receiver
	21	**RX+**	Receiver

20.6 Remote pressure transducer connections - only for **SF**, **SL**

CABLE ENTRANCES	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES	SL - Single transducer (1)		SF - Double transducers (1)	
					Voltage	Current	Voltage	Current
D1 D2	33	**TR2**	2nd signal transducer ±10 VDC / ±20 mA maximum range	Input - analog signal **Software selectable**	/	/	Connect	Connect
	34	**TR1**	1st signal transducer ±10 VDC / ±20 mA maximum range	Input - analog signal **Software selectable**	Connect	Connect	Connect	Connect
	35	**AGND**	Common gnd for transducer power and signals	Common gnd	Connect	/	Connect	/
	36	**VF +24V**	Power supply +24VDC	Output - power supply	Connect	Connect	Connect	Connect

E-ATRA remote pressure transducer connection - see tech table **GX800**

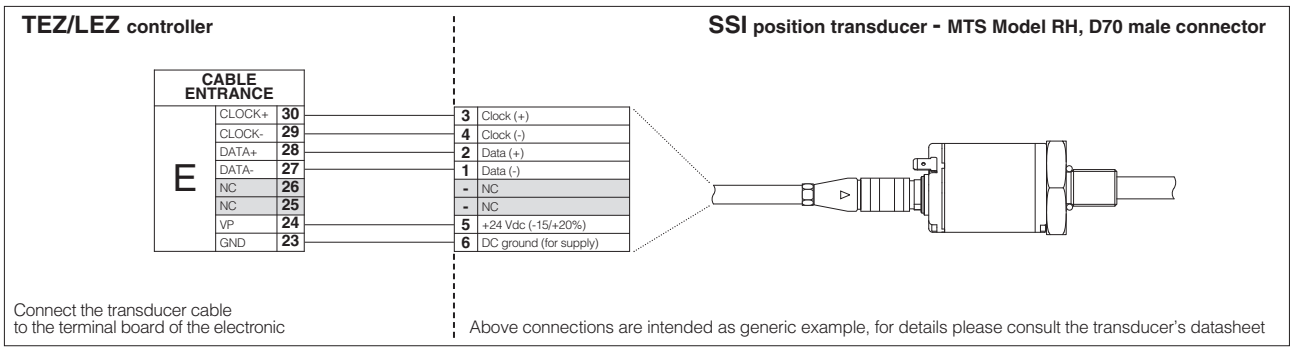


20.7 D execution - Digital position transducers connections

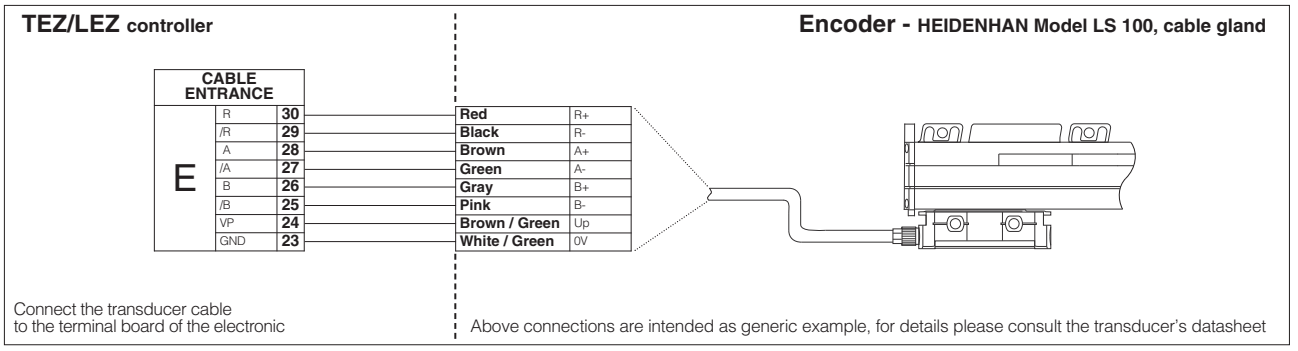
CABLE ENTRANCE	PIN	SSI - default transducer (1)			Encoder (1)		
		SIGNAL	TECHNICAL SPECIFICATION	NOTES	SIGNAL	TECHNICAL SPECIFICATION	NOTES
E	30	**CLOCK+**	Serial syncronous clock (+)	Input - digital signal	**R**	Input channel R	Input - digital signal
	29	**CLOCK-**	Serial syncronous clock (-)		**/R**	Input channel /R	
	28	**DATA+**	Serial position data (+)		**A**	Input channel A	
	27	**DATA-**	Serial position data (-)		**/A**	Input channel /A	
	26	**NC**	Not connect	Do not connect	**B**	Input channel B	
	25	**NC**			**/B**	Input channel /B	
	24	**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**
	23	**GND**	Common gnd for transducer powerand signals	Common gnd	**GND**	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



Encoder connection - example



20.8 A execution - Analog position transducers connector

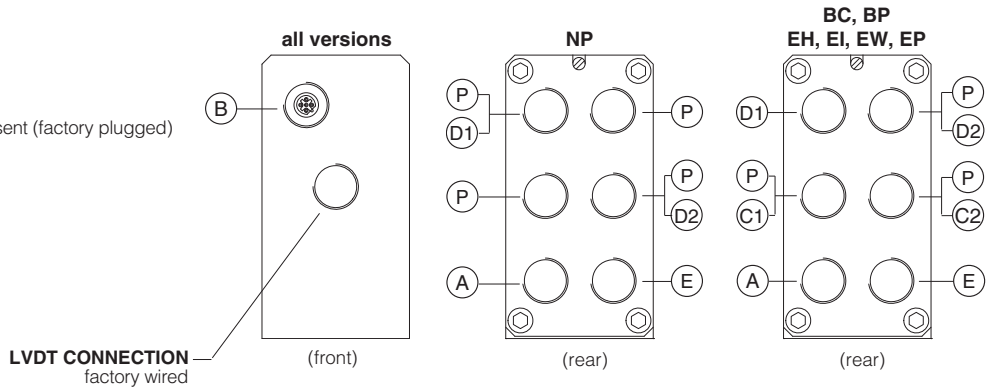
CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATION	NOTES
E	32	**TR**	Signal transducer	Input - analog signal
	24	**VP**	Power supply: +24VDC or OFF (default OFF)	Output - power supply **Software selectable**
	23	**GND**	Common gnd for transducer power and signals	Common gnd

21 CONNECTIONS LAYOUT

CABLE ENTRANCE OVERVIEW

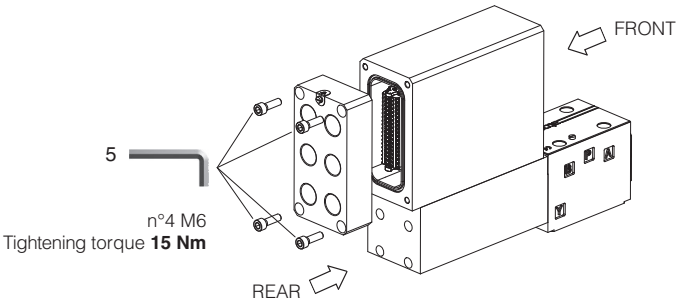
Cables entrance description:

- (A) main connections
- (B) USB connector always present (factory plugged)
- (C1) fieldbus (input)
- (C2) fieldbus (output)
- (D1) pressure transducer 1
- (D2) pressure transducer 2
- (E) position transducer
- (P) threaded plug



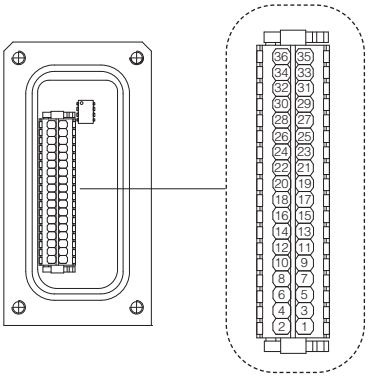
TERMINAL BOARD AND FIELDBUS TERMINATOR

Remove the 4 screws of driver's rear cover to access terminal board and fieldbus terminator

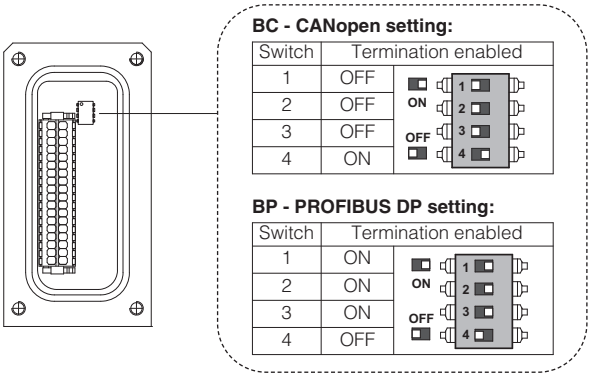


⚠ **WARNING:** the above operation must be performed in a safety area

Terminal board - see section 19



Fieldbus terminator only for BC and BP executions **(1)**



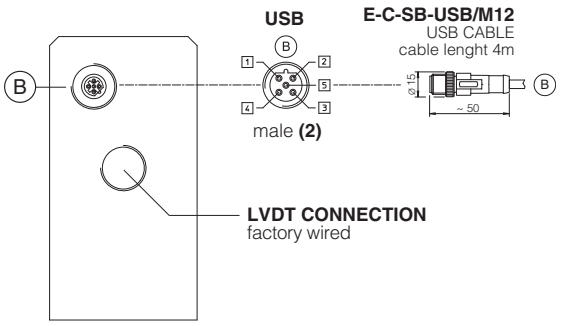
BC - CANopen setting:

Switch	Termination enabled
1	OFF
2	OFF
3	OFF
4	ON

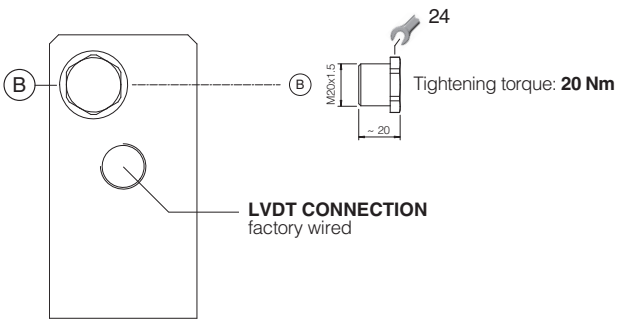
BP - PROFIBUS DP setting:

Switch	Termination enabled
1	ON
2	ON
3	ON
4	OFF

USB CONNECTOR

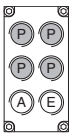
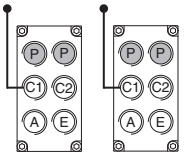
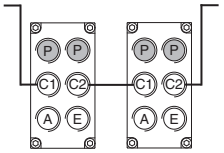


METALLIC PROTECTION CAP - supplied with the valves

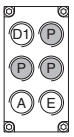
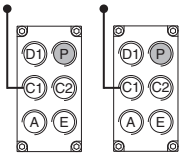
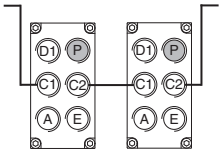


(1) Drivers with BC and BP fieldbus interface are delivered by default 'Not Terminated'. All switches are set OFF
(2) Pin layout always referred to driver's view

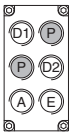
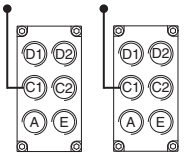
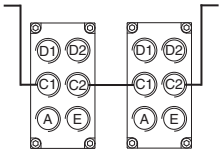
21.1 Cable glands and threaded plug for SN - see tech table **KX800**

Communication interfaces	To be ordered separately				Cable entrance overview	Notes
	Cable gland quantity	entrance	Threaded plug quantity	entrance		
NP	2	A - E	none	none		Cable entrance A, E are open for costumers Cable entrance P are factory plugged
BC, BP, EH, EW, EI, EP "via stub" connection	3	C1 A - E	1	C2		Cable entrance A, E, C1, C2 are open for costumers Cable entrance P are factory plugged
BC, BP, EH, EW, EI, EP "daisy chain" connection	4	C1 - C2 A - E	none	none		Cable entrance A, E, C1, C2 are open for costumers Cable entrance P are factory plugged

21.2 Cable glands and threaded plug for SL - see tech table **KX800**

Communication interfaces	To be ordered separately				Cable entrance overview	Notes
	Cable gland quantity	entrance	Threaded plug quantity	entrance		
NP	3	D1 A - E	none	none		Cable entrance A, E, D1 are open for costumers Cable entrance P are factory plugged
BC, BP, EH, EW, EI, EP "via stub" connection	4	D1 C1 A - E	1	C2		Cable entrance A, E, C1, C2, D1 are open for costumers Cable entrance P are factory plugged
BC, BP, EH, EW, EI, EP "daisy chain" connection	5	D1 C1 - C2 A - E	none	none		Cable entrance A, E, C1, C2, D1 are open for costumers Cable entrance P are factory plugged

21.3 Cable glands and threaded plug for SF - see tech table **KX800**

Communication interfaces	To be ordered separately				Cable entrance overview	Notes
	Cable gland quantity	entrance	Threaded plug quantity	entrance		
NP	4	D1 D2 A - E	none	none		Cable entrance A, E, D1, D2 are open for costumers Cable entrance P are factory plugged
BC, BP, EH, EW, EI, EP "via stub" connection	5	D1 - D2 C1 A - E	1	C2		Cable entrance A, E, C1, C2, D1, D2 are open for costumers
BC, BP, EH, EW, EI, EP "daisy chain" connection	6	D1 - D2 C1 - C2 A - E	none	none		Cable entrance A, E, C1, C2, D1, D2 are open for costumers

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

22.1 External reference and transducer parameters

Allow to configure the controller 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 controller 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 controller 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 controller detects and reacts 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, controller 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

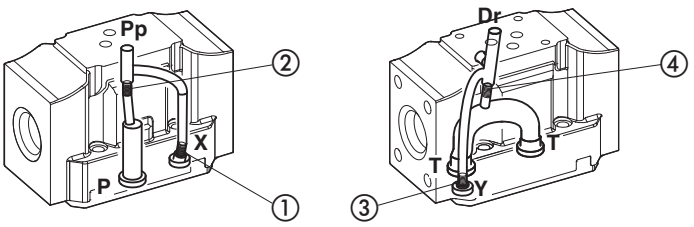
22.6 Motion phases parameters

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 PLUGS LOCATION FOR PILOT/DRAIN CHANNELS

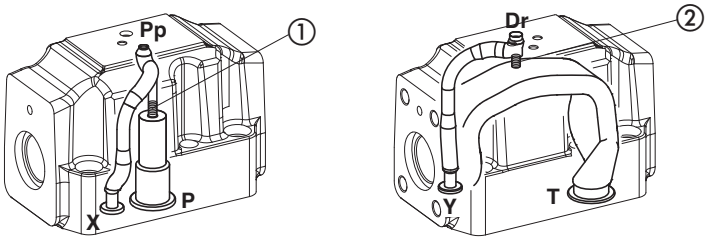
Depending on the position of internal plugs, different pilot/drain configurations can be obtained as shown below.
To modify the pilot/drain configuration, proper plugs must only be interchanged. The plugs have to be sealed using loctite 270.
Standard valves configuration provides internal pilot and external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

DPZA-1 **Pilot channels** **Drain channels**



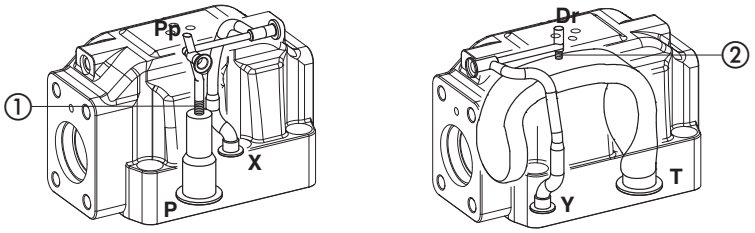
Internal piloting: blinded plug SP-X300F ① in X;
External piloting: blinded plug SP-X300F ② in Pp;
Internal drain: blinded plug SP-X300F ③ in Y;
External drain: blinded plug SP-X300F ④ in Dr.

DPZA-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.

DPZA-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.

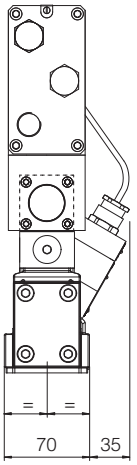
24 FASTENING BOLTS AND SEALS

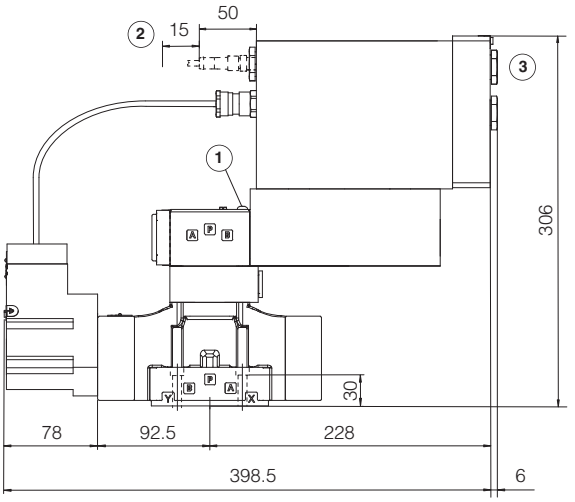
Type	Size	Fastening bolts	Seals
DPZA	**1** = 10	4 socket head screws M6x40 class 12.9 Tightening torque = 15 Nm	5 OR 2050; Diameter of ports A, B, P, T: Ø 11 mm (max) 2 OR 108 Diameter of ports X, Y: Ø = 5 mm (max)
	2 = 16	4 socket head screws M10x50 class 12.9 Tightening torque = 70 Nm 2 socket head 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)

DPZA-LEZ-*-1

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

Mass [kg]	
DPZA-*-17*	13,7
Option /G	+0,9

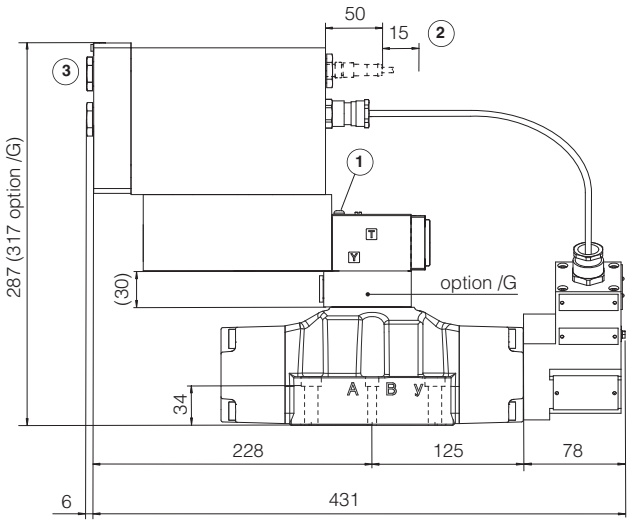


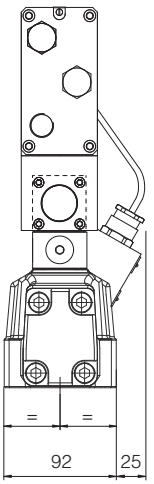


DPZA-LEZ-*-2

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

Mass [kg]	
DPZA-*-27*	17,9
Option /G	+0,9





(1) = Air bleed off

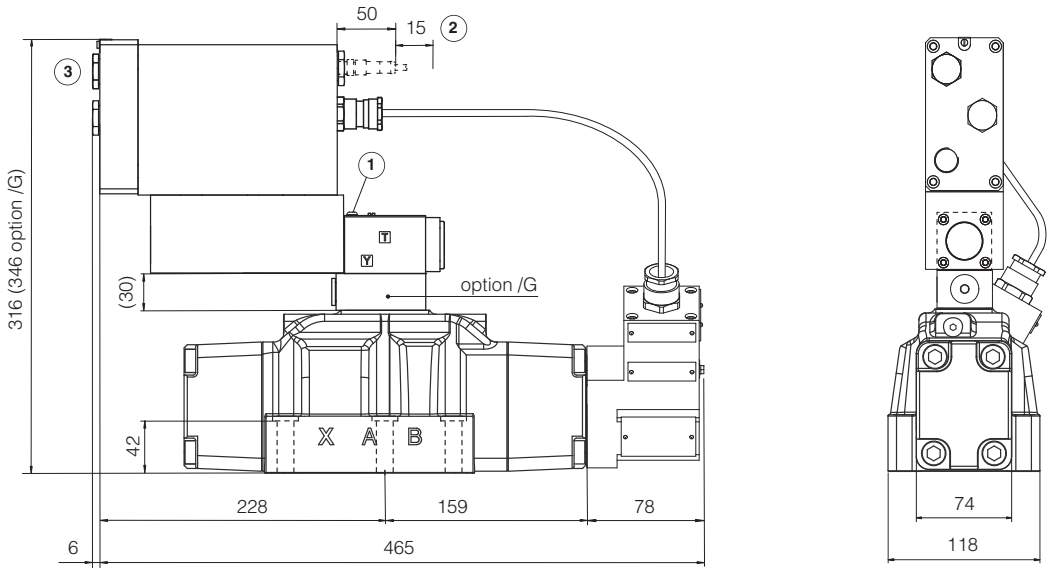
(2) = Space to remove the USB connector

(3) = The dimensions of cable glands must be considered (see tech table **KX800**)

DPZA-LEZ-*-4
DPZA-LEZ-*-4M

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

Mass [kg]	
DPZA-*-4*	23,1
DPZA-*-4M*	23,1
Option /G	+0,9



(1) = Air bleed off

(2) = Space to remove the USB connector

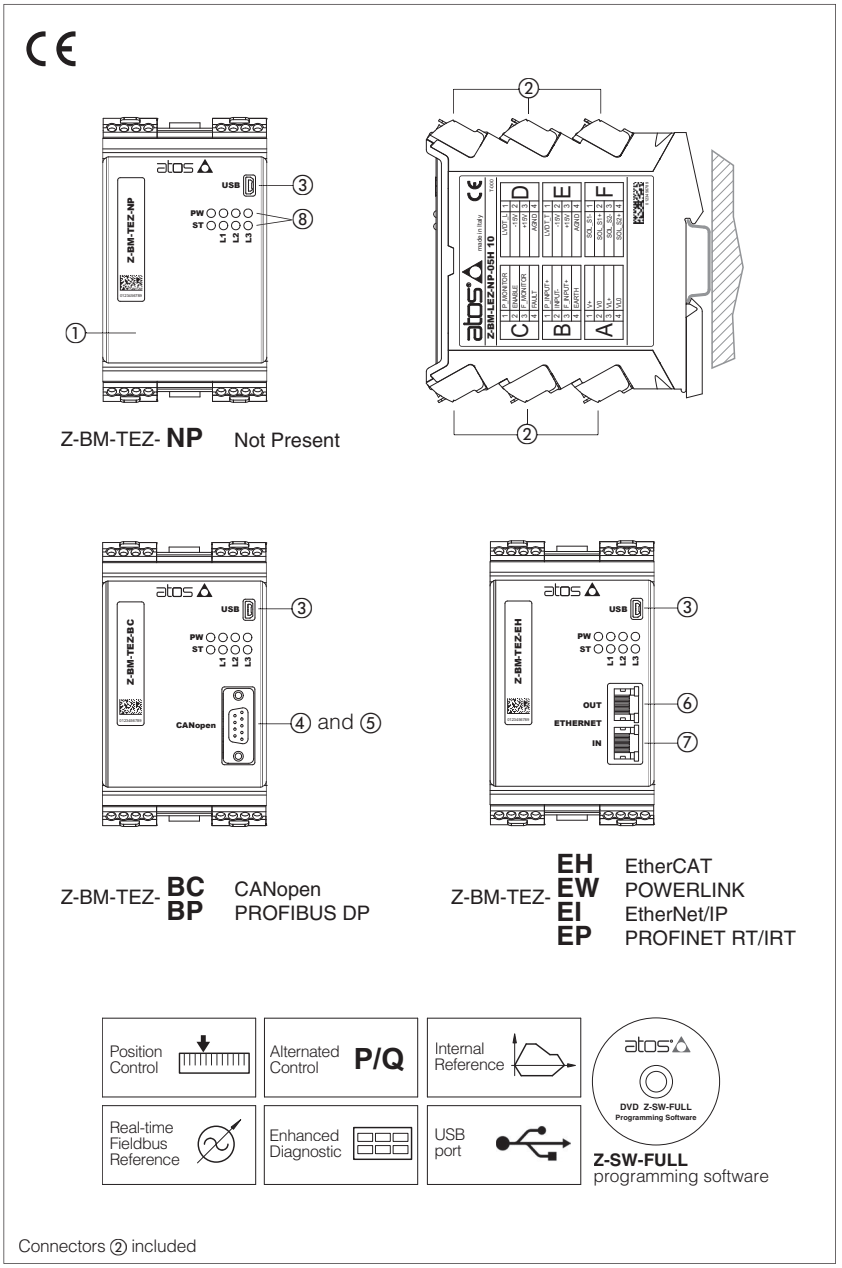
(3) = The dimensions of cable glands must be considered (see tech table **KX800**)

26 RELATED DOCUMENTATION

X010	Basics for electrohydraulics in hazardous environments	**GS510**	Fieldbus
X020	Summary of Atos ex-proof components certified to ATEX, IECEx, EAC, PESO	**GX800**	Ex-proof pressure transducer type E-ATRA-7
FX900	Operating and manintenance information for ex-proof proportional valves	**KX800**	Cable glands for ex-proof valves
GS500	Programming tools	**P005**	Mounting surfaces for electrohydraulic valves

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

DIN-rail format, for position and force controls



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 integral or external position transducer (analog, SSI or Encoder) to feedback the axis position.

The controller is operated by an external or internally generated reference position signal (see section 4).

A pressure/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 controller; a second pressure/force reference signal is required.

Atos PC software allows to customize the controller 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'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	-	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

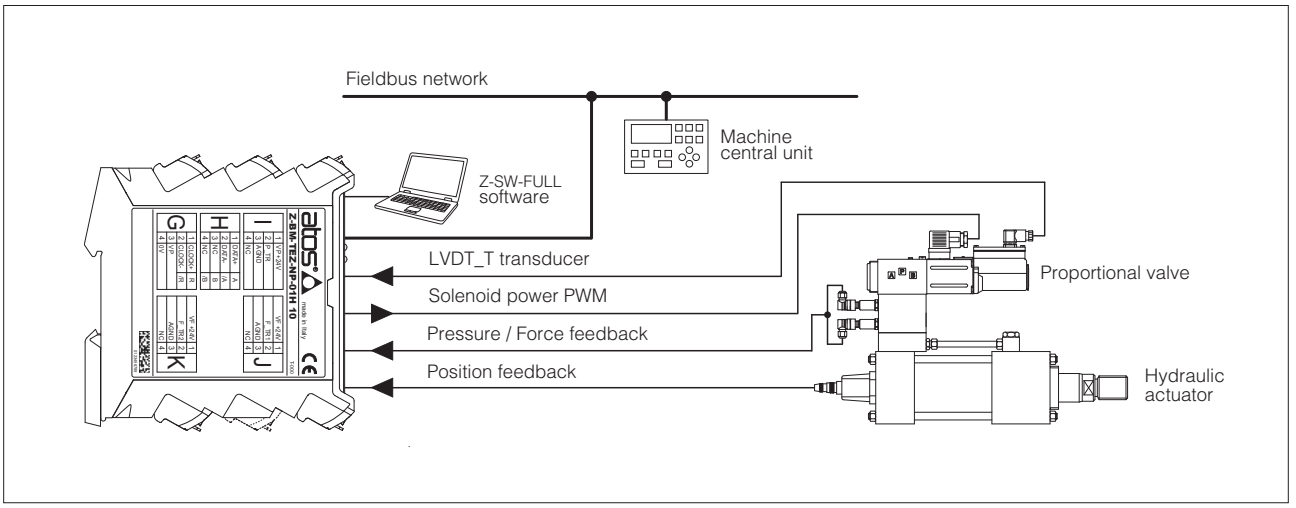
01H = for single solenoid proportional valves
05H = for double solenoid proportional valves (only for **TEZ**)

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		
Standard Data sheet	**DHZO-T, DKZOR-T** F165	**DLHZO-T, DLKZOR-T** F180	**DPZO-L** F175
Ex-proof Data sheet	-	**DLHZA-T, DLKZA-T** FX140	-
Controller model	**Z-BM-TEZ**		**Z-BM-LEZ**

4 POSITION REFERENCE MODE

4.1 External reference generation

Axis controller regulates in closed loop the actuator position according to an external reference position signal and to the position feedback from the actuator transducer.

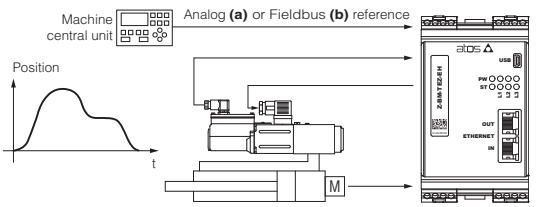
The external reference signal can be software selected among:

Analog reference (a) - the controller receives in real time the reference signal from the machine electronic central unit by means analog input (see 8.2) limiting speed, acceleration and deceleration values.

Fieldbus reference (b) - the controller receives in real time the reference signal from the machine electronic central unit by means digital fieldbus communication limiting speed, acceleration and deceleration values.

For fieldbus communication details, please refer to the controller user manual.

External reference generation



4.2 Internal reference generation

Axis controller regulates in closed loop the actuator position according to an internally generated reference position signal and to the position feedback from the actuator transducer. The internal reference signal is generated by a pre-programmed cycle; only start, stop and switch-over commands are required from the machine electronic central unit by means of:

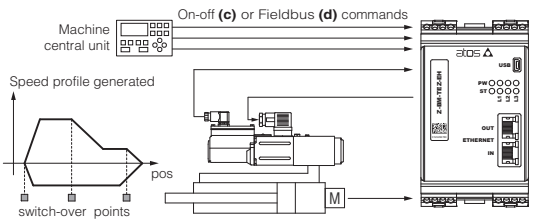
- *on-off commands* ***(c)***

- *fieldbus commands* ***(d)***

Atos PC software allows to design a customized sequence of motion phases through a range of pre-defined standard commands.

Start/stop/switch-over commands and reference generation type can be set for each phase in order to realize an automatic cycle according to the application requests. Refer to the controller user manual for further details on commands and reference generation type.

Internal reference generation



Start / stop / switch-over commands examples

External digital input	on-off commands are used to start/stop the cycle generation or to change the motion phase
External fieldbus input	on-off commands, by fieldbus communication, are used to start/stop the cycle generation or to change the motion phase
Switch by position	switch-over from actual to following motion phase occurs when the actual position reaches a programmed value
Switch by time	switch-over from actual to following motion phase occurs after a fixed time, starting from the actual phase activation
Switch by internal status	switch-over from internal status are used to start/stop the cycle generation or to change the motion phase

Reference generation types examples

Absolute	a target position reference signal is internally generated for each motion phase; maximum speed and acceleration can be set to obtain a smooth and precise position control
Relative	as 'Absolute' but the target position corresponds to the actuator position plus a fixed quote internally set by software

5 ALTERNATED POSITION / FORCE CONTROL

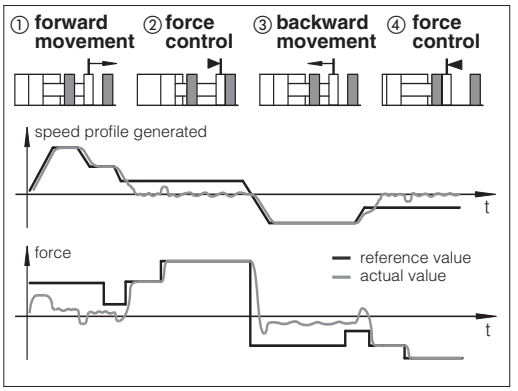
Alternated pressure or force closed loop control can be added to the actuator's standard position control, requiring one or two remote transducers (pressure or force) that have to be installed on the actuator, see below functional schemes.

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.

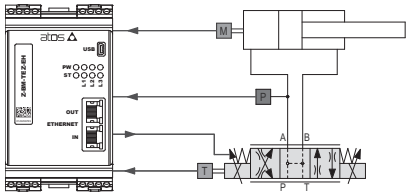
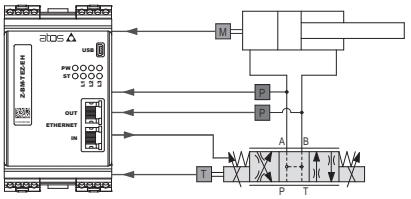
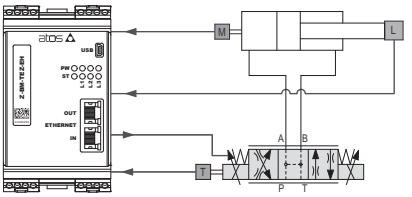
The dynamics of the switching between the two controls can be regulated thanks to specific software setting, in order to avoid instability and vibrations.

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 controller 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

SP	SF	SL
		
one remote pressure transducer has to be installed on the actuator's port to be controlled	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

SP – position/pressure control
Adds pressure control to standard position control and permits to limit the max force in one direction controlling in closed loop the pressure acting on one side of the hydraulic actuator. A single pressure transducer has to be installed on hydraulic line to be controlled.

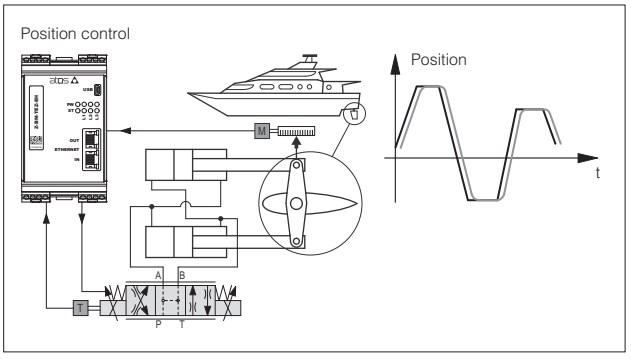
SF – position/force control
Adds force control to standard position control and permits to limit the max force in two directions controlling in closed loop the delta pressure acting on both sides of the hydraulic actuator. Two pressure transducers have to be installed on both hydraulic line.

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 **GS002**
- Atos technical service is available for additional evaluations related to specific applications usage

6 APPLICATION EXAMPLES

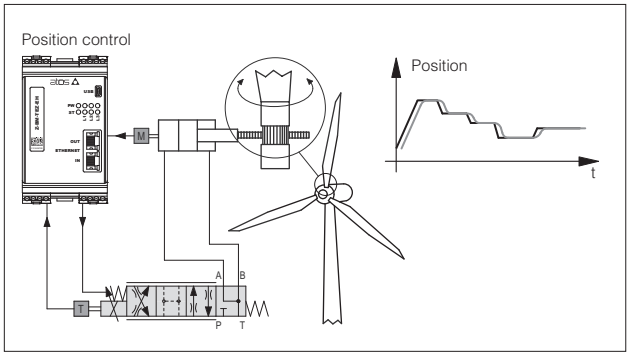


Hydraulic steering wheel in marine applications

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

Z-BM-TEZ/LEZ controllers 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

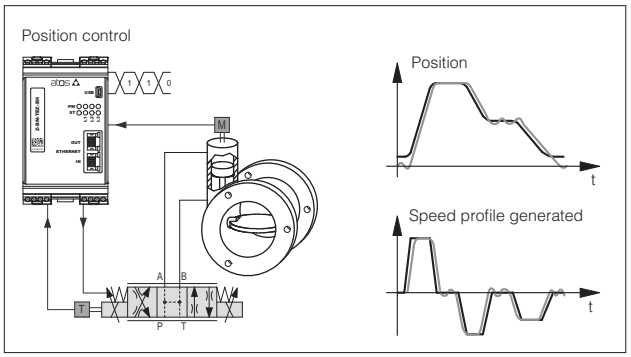


Wind turbines

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 controllers 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

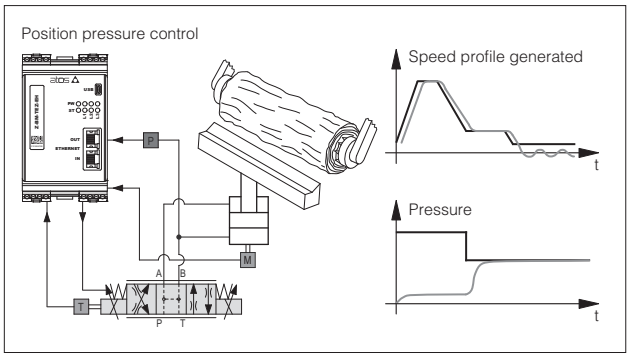


Process valves

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

Z-BM-TEZ/LEZ controllers 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

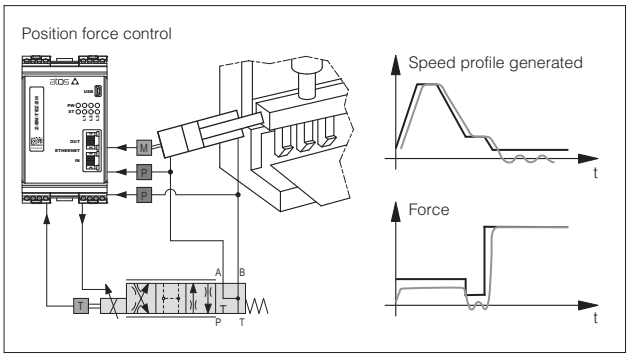


Wood machinery

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

Z-BM-TEZ/LEZ controllers 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 controller state indication

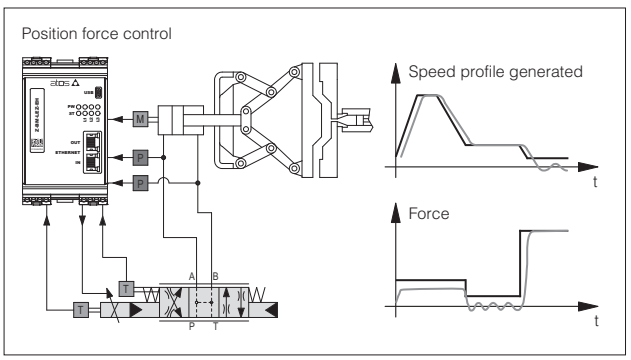


Bending Machines

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 controller 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 controllers, with alternated position/force control, simplify the hydraulic + electronic system architecture, thanks to:

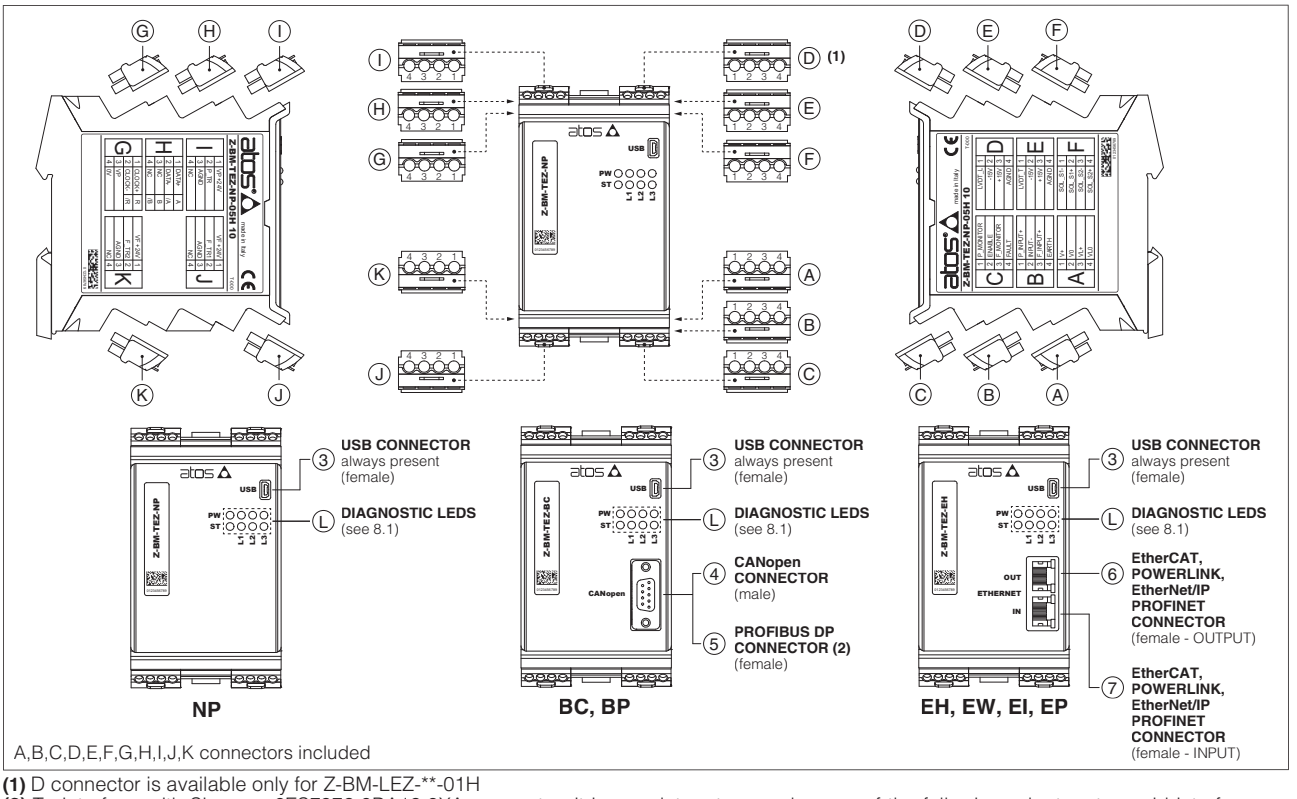
- internal reference generation for repetitive working cycles
- SSI digital position transducer for accurate axis control
- two pressure transducers for alternated force control
- auxiliary digital inputs/output to synchronize the machine functions
- fieldbus connection for machine remote control and 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 driver IMAX = 2.5 A for ex-proof driver (**/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				
Electromagnetic compatibility (EMC)	According to Directive 2014/30/UE (Immunity: EN 61000-6-2; Emission: EN 61000-6-3)				
Compliance	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 driver energizing with the 24 VDC power supply and when the valve is ready to operate. During this time the current to the valve coils is switched to zero.

8 CONNECTIONS AND LEDS



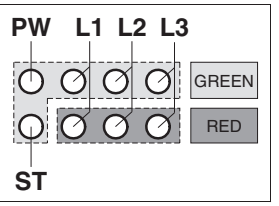
(1) D connector is available only for Z-BM-LEZ-**-01H

(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 controller operative conditions for immediate basic diagnostics. Please refer to the controler 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 driver's logic and communication (see 10.2)	Input - power supply
	A4	**VL0**	Power supply 0 VDC for driver's 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+**	Pressure/Force reference input signal (SP, 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 controller, referred to VL0 (see 10.7)	Input - on/off signal
	C3	**F_MONITOR**	Pressure/Force (SP, 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 position transducer signal (see 10.11)	Input - analog signal
	D2	**-15V**	Main stage valve position transducer power supply -15V	Output power supply
	D3	**+15V**	Main stage valve position transducer power supply +15V	Output power supply
	D4	**AGND**	Common gnd for transducer power and monitor outputs	Common gnd
E	E1	**LVDT_T**	Direct valve or pilot valve position transducer signal (see 10.11)	Input - analog signal
	E2	**-15V**	Direct valve or pilot valve position transducer power supply -15V	Output power supply
	E3	**+15V**	Direct valve or pilot valve position transducer power supply +15V	Output power supply
	E4	**AGND**	Common gnd for transducer power 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 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 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 and signals	Common gnd
	K4	**NC**	Do not connect	

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

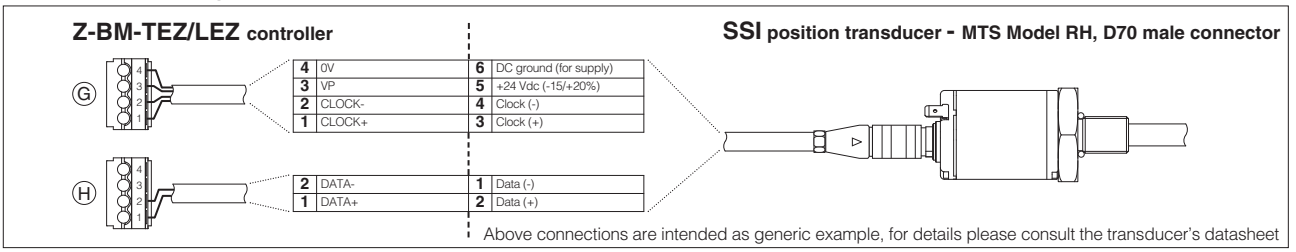
8.3 SSI connectors signals - 4 pin

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

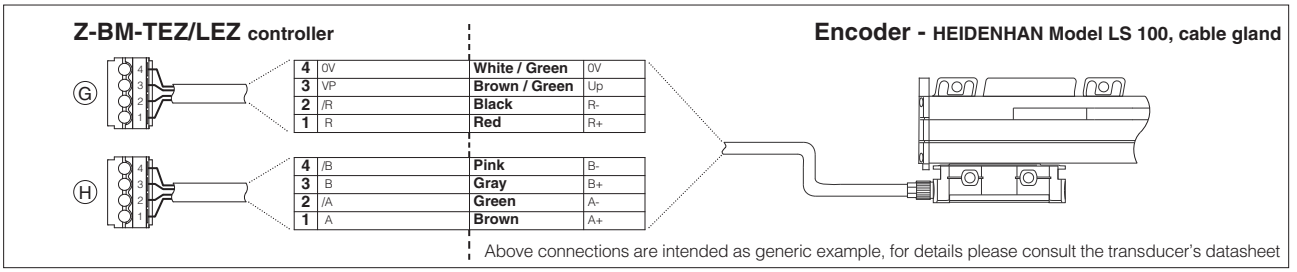


8.4 Encoder connectors signals - 4 pin

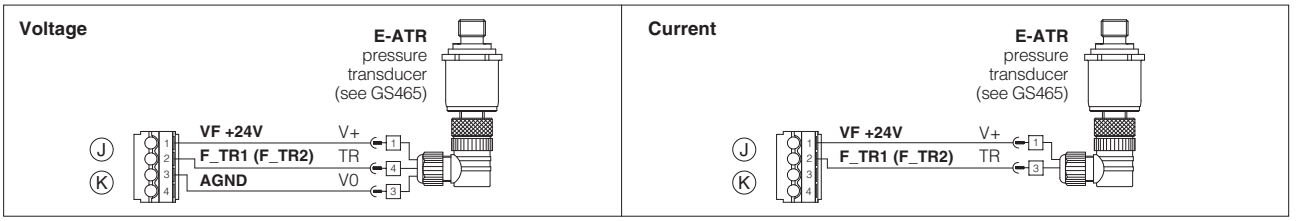
G	G1	**R**	Input channel R	Input - on/off signal
	G2	**/R**	Input channel /R	Input - on/off signal
	G3	**VP**	Power supply: +24VDC , +5VDC or OFF (default OFF)	Output - power supply **Software selectable**
	G4	**0V**	Common gnd for transducer power and signals	Common gnd

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

10 SIGNALS SPECIFICATIONS

Atos digital drivers 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 **F003** 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 driver's logic and communication (VL+ and VL0)

The power supply (pin A3 and A4) for driver's logic and communication must be appropriately stabilized or rectified and filtered: apply at least a 10000 µF/40 V capacitance to single phase rectifiers or a 4700 µF/40 V capacitance to three phase rectifiers.
The separate power supply for driver's logic, 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 driver's 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 controllers' reference mode, see section 4 :
external analog reference generation (see 4.1): input is used as reference for the controller position 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

fieldbus/internal reference generation (see 4.2)*:* analog reference input signal can be used as on-off commands with input range 0 ÷ 24VDC.

10.4 Pressure or force reference input signal (F_INPUT+)

Functionality of F_INPUT+ signal (pin B3), depends on selected controllers' reference mode and alternated control options, see section 5 :
SP, SL, SF controls and external analog reference selected : input is used as reference for the controller 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/internal 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 controller 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 controller (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 Pressure or force monitor output signal (F_MONITOR)

The controller generates an analog output signal (pin C3) according to alternated pressure/force control option:
SN control: output signal is proportional to the actual valve spool positio
SP, 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 controller (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 controller, a 24VDC voltage has to be applied on pin C2
When the Enable signal is set to zero the controller 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 controller (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 controller. 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) - SP, SF, SL controls

Analog remote pressure transducers or load cell can be directly connected to the controller.
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 controller 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 driver 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 controllers, 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 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 both alternated position/pressure and 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
Controller 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 controller **(2)** percentage of total stroke **(3)** for Balluff BTL7 with SSI interface only special code SA433 is supported

12 VALVE SETTINGS AND PROGRAMMING TOOLS

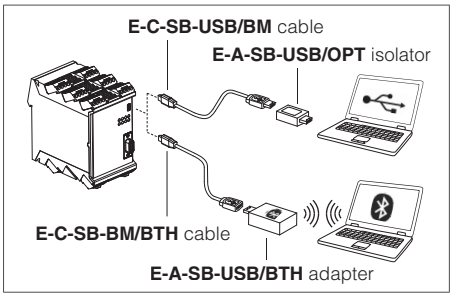
Valve's functional parameters and configurations, can be easily set and optimized using Atos Z-SW programming software connected via USB port to the digital controller (see table **GS003**). For fieldbus versions, the software permits valve's parameterization through USB port also if the controller is connected to the central machine unit via fieldbus.

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

Z-SW-FULL support: NP (USB) PS (Serial) IR (Infrared)
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/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 s 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 controller 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 controller 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 controller 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 controller 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, controller disabling, etc.)

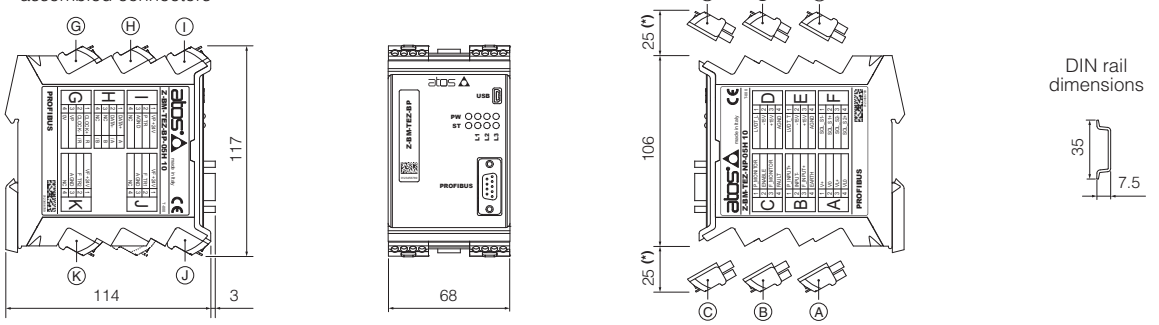
13.5 Valve characteristics compensation

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]



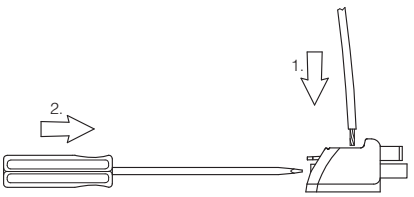
A,B,C,D,E,F,G,H,I,J,K connectors included

(*) Space to remove the connectors

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

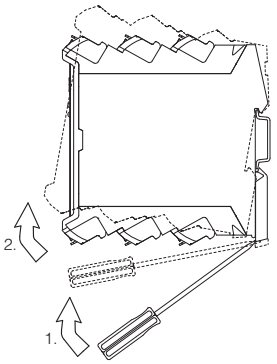
15 INSTALLATION

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 controller from the DIN rail:
1. pull down the locking slide with a screwdriver
2. rotate up the controller



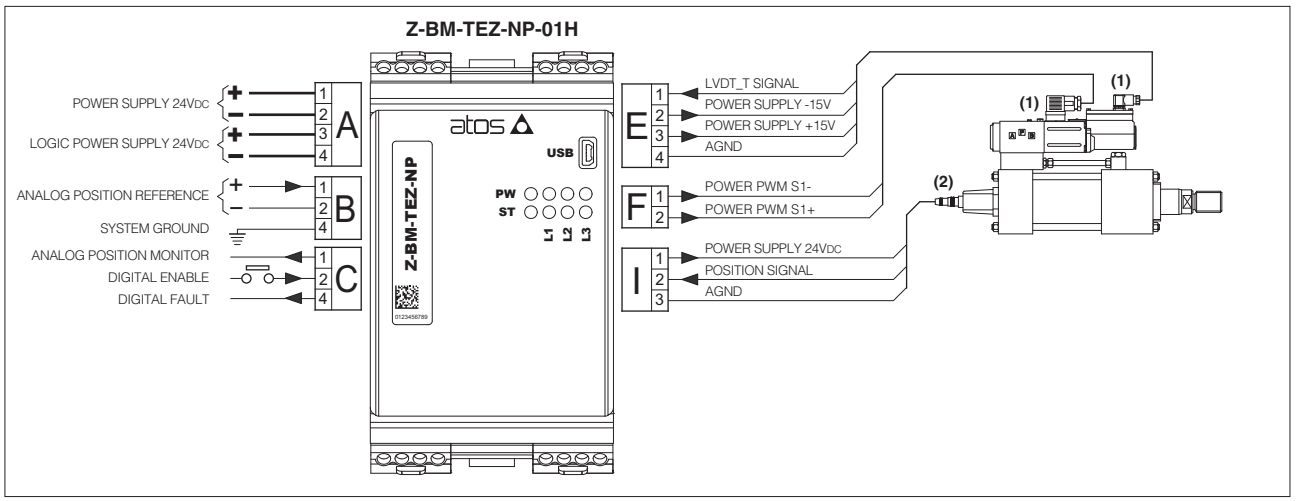
To extract the connectors:
1. push lever
2. pull connector

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)

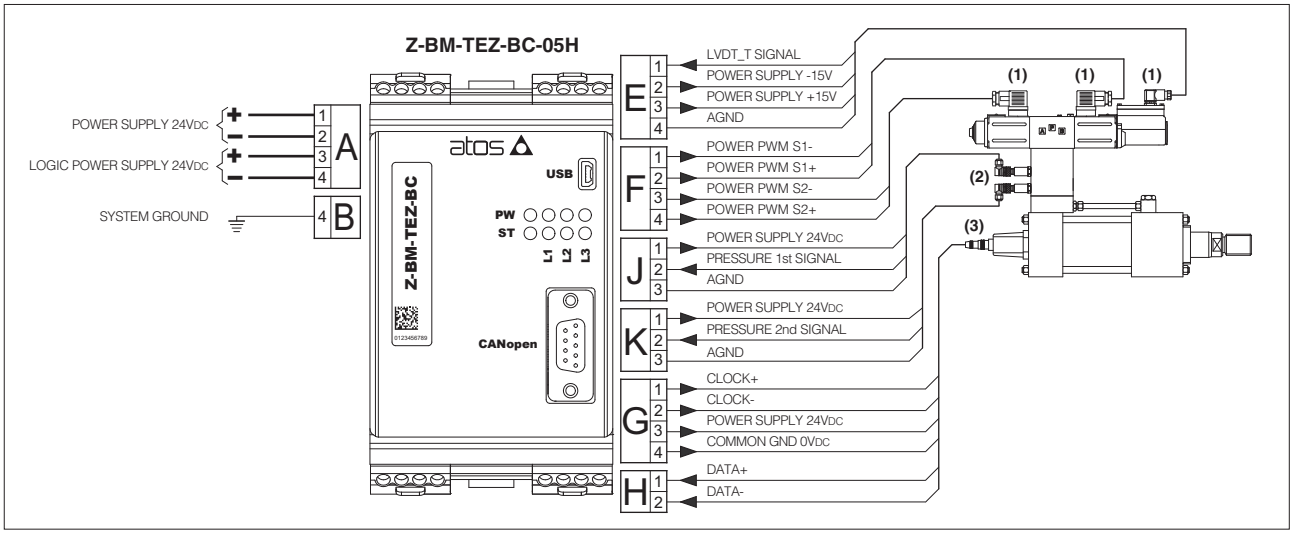
16 WIRING EXAMPLES

16.1 Position control - analog reference - analog position transducer



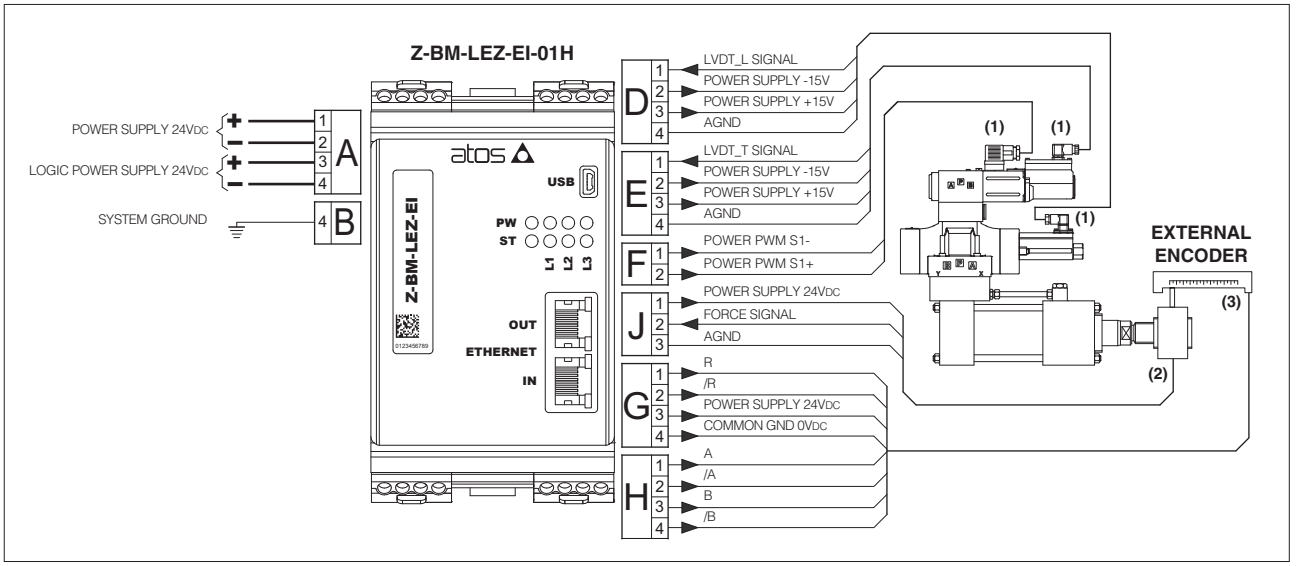
(1) For valve electrical connections please refer to the specific technical table
(2) The analog position transducer connections are intended as generic example, for details please consult the transducer's datasheet

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's datasheet

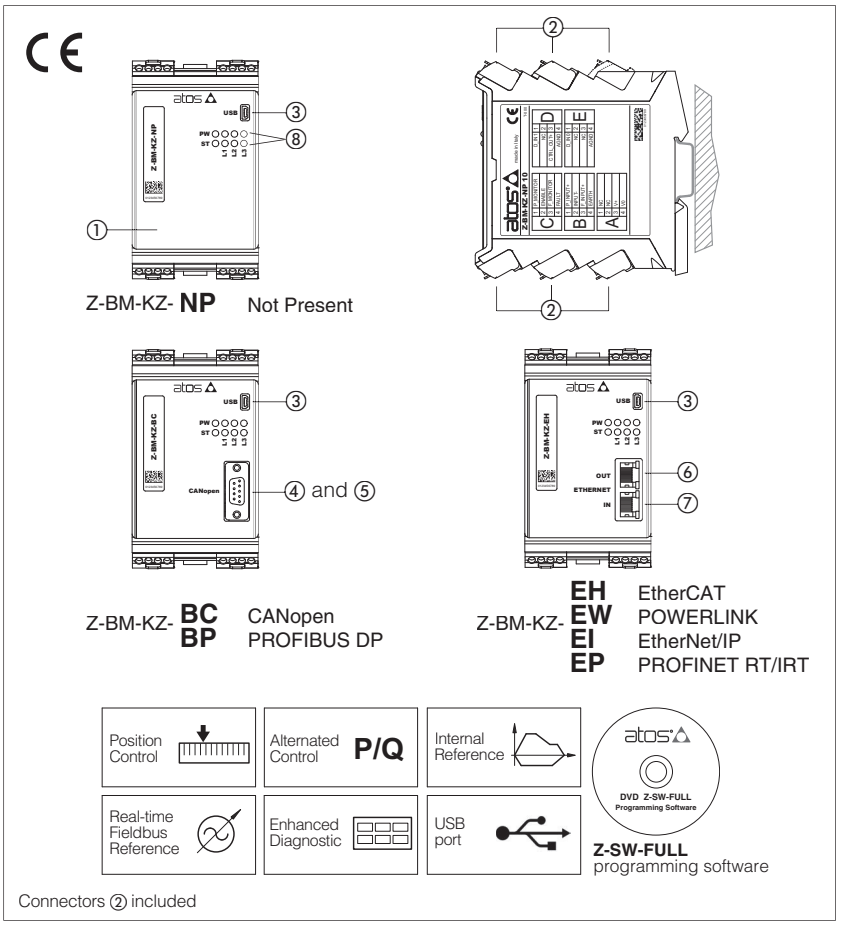
16.3 Alternated position/force control - EtherNet/IP reference - Encoder position transducer - analog load cell



(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's 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 controller generates a reference signal to the proportional valve which regulates the hydraulic flow to the actuator.

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

The controller is operated by an external or internally generated reference position signal (see section 4).

A pressure/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 controller; a second pressure/force reference signal is required.

Atos PC software allows to customize the controller 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

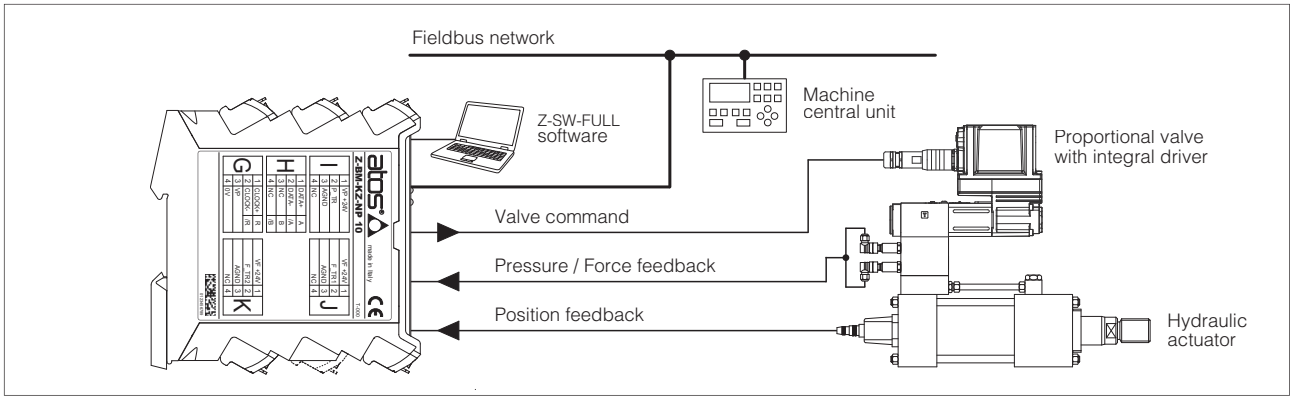
Software Features:

- 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					
Standard Data sheet	**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 Data sheet	-	**DHZA-TES, DKZA-TES** FX135	-	**DLHZA-TES, DLKZA-TES** FX150	-	**DPZA-LES** FX235
Controller model	**Z-BM-KZ**					

4 POSITION REFERENCE MODE

4.1 External reference generation

Axis controller regulates in closed loop the actuator position according to an external reference position signal and to the position feedback from the actuator transducer. It generates a reference signal for the proportional valve which regulates the hydraulic flow to the actuator.

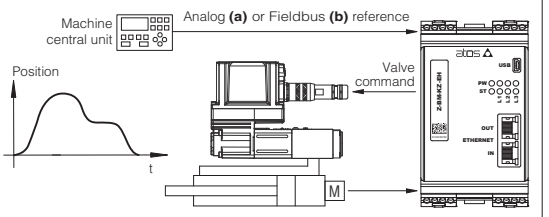
The external reference signal can be software selected among:

Analog reference (a) - the controller receives in real time the reference signal from the machine electronic central unit by means analog input (see 8.2) limiting speed, acceleration and deceleration values.

Fieldbus reference (b) - the controller receives in real time the reference signal from the machine electronic central unit by means digital fieldbus communication limiting speed, acceleration and deceleration values.

For fieldbus communication details, please refer to the controller user manual.

External reference generation



4.2 Internal reference generation

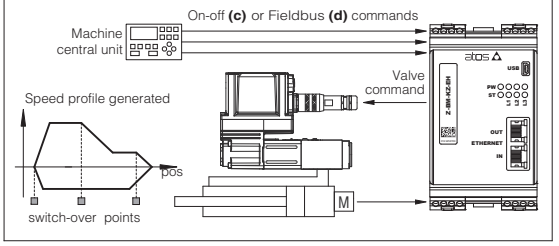
Axis controller regulates in closed loop the actuator position according to an internally generated reference position signal and to the position feedback from the actuator transducer.It generates a reference signal for the proportional valve which regulates the hydraulic flow to the actuator.

The internal reference signal is generated by a pre-programmed cycle; only start, stop and switch-over commands are required from the machine electronic central unit by means of:

- on-off commands ***(c)***

- fieldbus commands ***(d)***

Internal reference generation



Atos PC software allows to design a customized sequence of motion phases through a range of pre-defined standard commands.

Start/stop/switch-over commands and reference generation type can be set for each phase in order to realize an automatic cycle according to the application requests. Refer to the controller user manual for further details on commands and reference generation type.

Start / stop / switch-over commands examples

External digital input	on-off commands are used to start/stop the cycle generation or to change the motion phase
External fieldbus input	on-off commands, by fieldbus communication, are used to start/stop the cycle generation or to change the motion phase
Switch by position	switch-over from actual to following motion phase occurs when the actual position reaches a programmed value
Switch by time	switch-over from actual to following motion phase occurs after a fixed time, starting from the actual phase activation
Switch by internal status	switch-over from internal status are used to start/stop the cycle generation or to change the motion phase

Reference generation types examples

Absolute	a target position reference signal is internally generated for each motion phase; maximum speed and acceleration can be set to obtain a smooth and precise position control
Relative	as 'Absolute' but the target position corresponds to the actuator position plus a fixed quote internally set by software

5 ALTERNATED POSITION / FORCE CONTROL

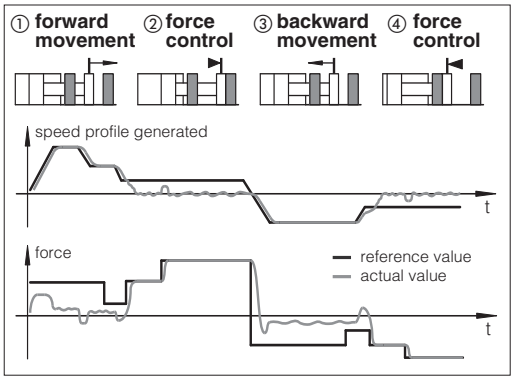
Alternated pressure or force closed loop control can be added to the actuator's standard position control, requiring one or two remote transducers (pressure or force) that have to be installed on the actuator, see below functional schemes.

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.

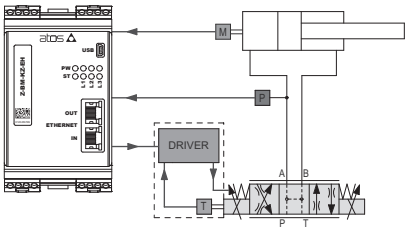
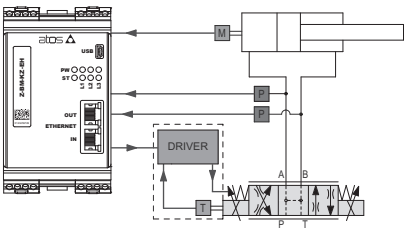
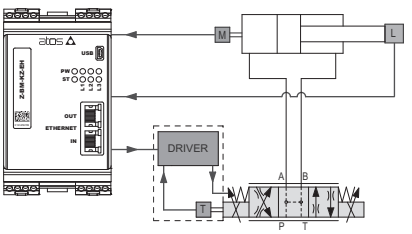
The dynamics of the switching between the two controls can be regulated thanks to specific software setting, in order to avoid instability and vibrations.

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 controller 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.



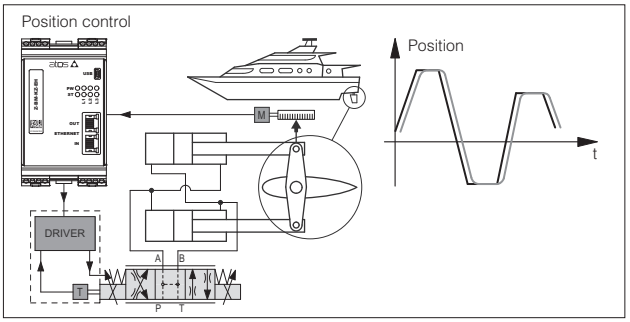
Alternated control configurations - software selectable

SP	SF	SL
		
one remote pressure transducer has to be installed on the actuator's port to be controlled	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

SP – position/pressure control
Adds pressure control to standard position control and permits to limit the max force in one direction controlling in closed loop the pressure acting on one side of the hydraulic actuator. A single pressure transducer has to be installed on hydraulic line to be controlled.
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 **GS002**
- Atos technical service is available for additional evaluations related to specific applications usage

6 APPLICATION EXAMPLES

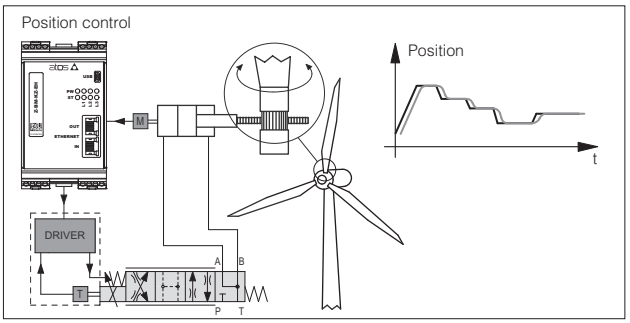


Hydraulic steering wheel in marine applications

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

Z-BM-KZ controllers 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

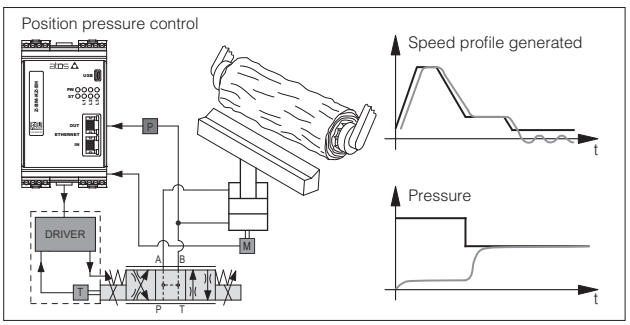


Wind turbines

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 controllers 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

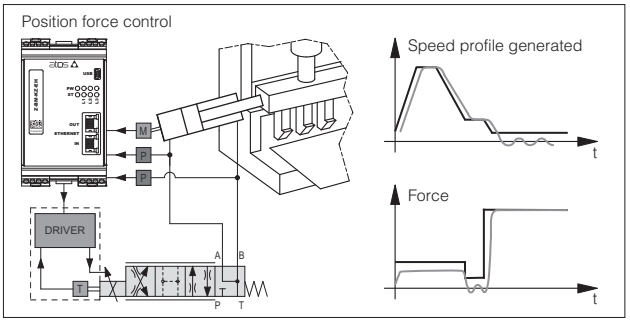


Wood machinery

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

Z-BM-KZ controllers 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 controller state indication

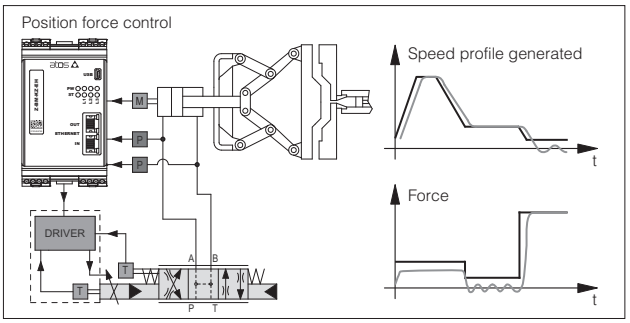


Bending Machines

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 controller 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.

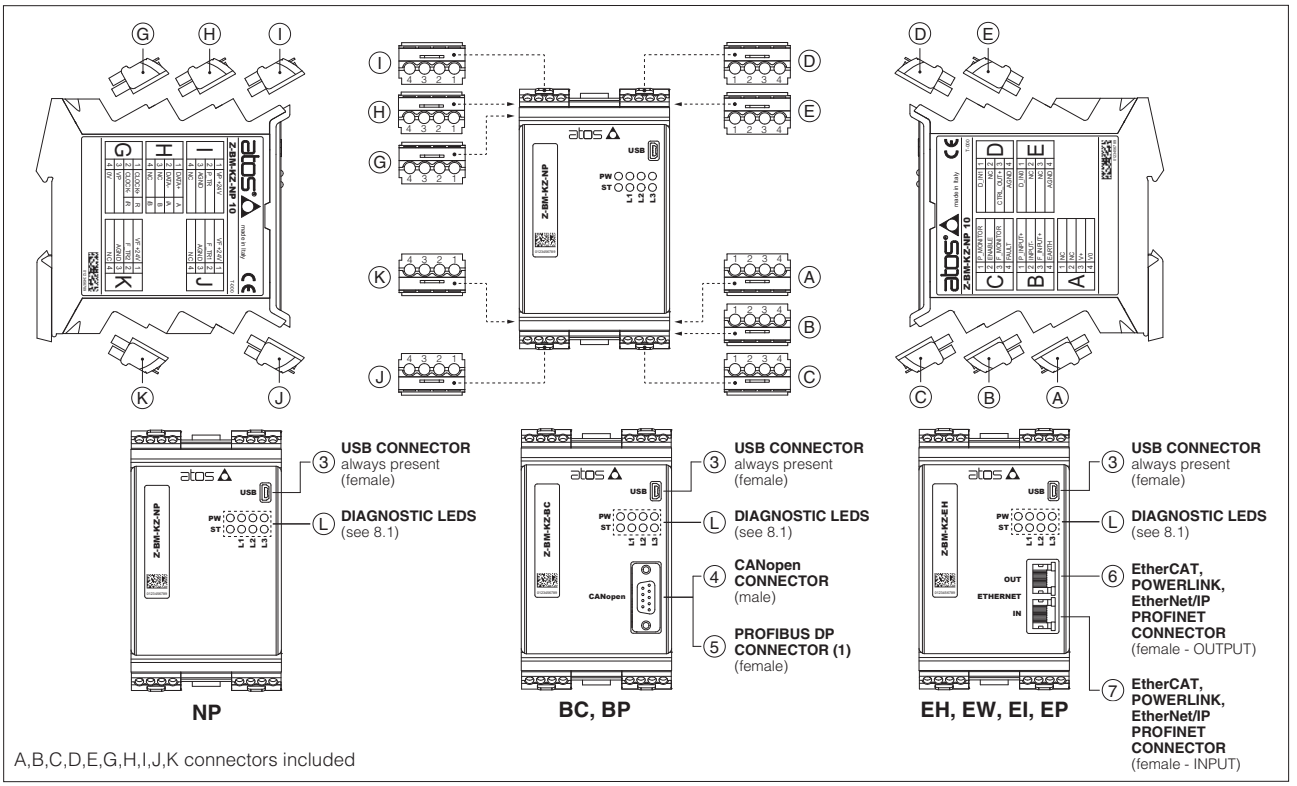
Z-BM-KZ controllers, with alternated position/force control, simplify the hydraulic + electronic system architecture, thanks to:

- 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 (see 9.4, 9.5) Control output (see 9.10)	Output range: voltage ±10 VDC @ max 5 mA current ±20 mA @ max 500 Ω load resistance			
Enable input (see 9.6) Digital inputs (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			
Electromagnetic compatibility (EMC)	According to Directive 2014/30/UE (Immunity: EN 61000-6-2; Emission: EN 61000-6-3)			
Compliance	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

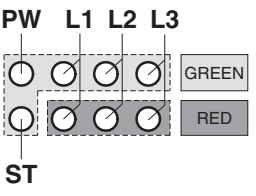


(1) To interface with Siemens 6ES7972-0BA12-0XA connector, it is mandatory to use also one of the following adapters to avoid interference with the USB connector: DG909MF1 - the connector will be oriented upwards; DG909MF3 - the connector will be oriented downwards

8.1 Diagnostic LEDs (L)

Eight leds show controller operative conditions for immediate basic diagnostics. Please refer to the controler 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+**	Pressure/Force reference input signal (SP, 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 controller, referred to V0 (see 9.6)	Input - on/off signal
	C3	**F_MONITOR**	Pressure/Force (SP, 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 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 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 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 and signals	Common gnd
	K4	**NC**	Do not connect	

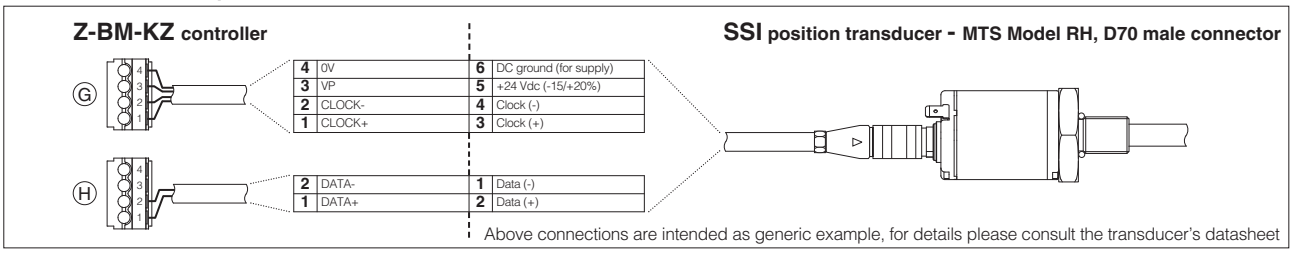
8.3 SSI connectors signals - 4 pin

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 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

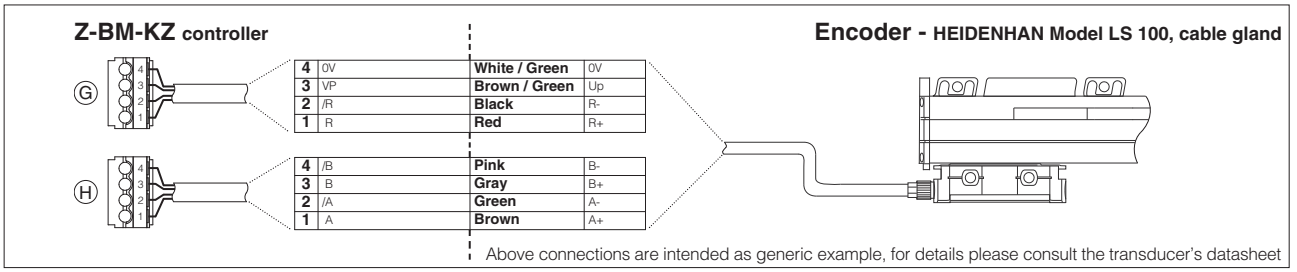


8.4 Encoder connectors signals - 4 pin

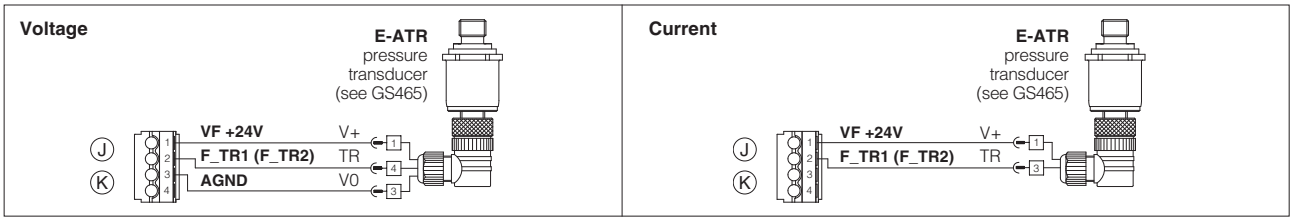
G	G1	**R**	Input channel R	Input - on/off signal
	G2	**/R**	Input channel /R	Input - on/off signal
	G3	**VP**	Power supply: +24VDC , +5VDC or OFF (default OFF)	Output - power supply **Software selectable**
	G4	**0V**	Common gnd for transducer power and signals	Common gnd

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)

⑥⑦ **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 controllers 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 **F003** 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 controllers' reference mode, see section 4 :
external analog reference generation (see 4.1): input is used as reference for the controller axis position 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

fieldbus/internal reference generation (see 4.2)*:* analog reference input signal can be used as on-off commands with input range 0 ÷ 24 VDC.

9.3 Pressure or force reference input signal (F_INPUT+)

Functionality of F_INPUT+ signal (pin B3), depends on selected controllers' reference mode and alternated control options, see section 5 :
SP, SL, SF controls and external analog reference selected : input is used as reference for the controller 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/internal 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 controller 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 controller (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 Pressure or force monitor output signal (F_MONITOR)

The controller generates an analog output signal (pin C3) according to alternated pressure/force control option:
SN control: output signal is proportional to the actual valve spool position
SP, 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 controller (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 controller, a 24 VDC voltage has to be applied on pin C2.
When the Enable signal is set to zero the controller 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 controller (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 controller. 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) - SP, SF, SL controls

Analog remote pressure transducers or load cell can be directly connected to the controller.
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 pressure / 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 controllers, 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 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 both alternated position/pressure and 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
Controller 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 controller **(2)** percentage of total stroke **(3)** for Balluff BTL7 with SSI interface only special code SA433 is supported

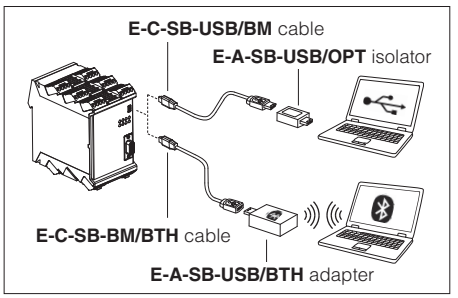
11 VALVE SETTINGS AND PROGRAMMING TOOLS

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 controller (see table **GS003**).
For fieldbus versions, the software permits valve's parameterization through USB port also if the controller 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**):

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

USB or Bluetooth connection



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

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 controller 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 controller 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 controller 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 controller 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, controller disabling, etc.)

12.5 Valve characteristics compensation

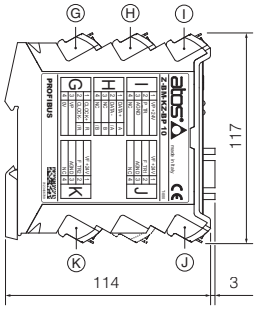
Allow to modify the valve regulation to match the actuator/system characteristics and to obtain the best overall performances:
- *Valve parameters* modify the standard valve regulation by means of deadband compensation, curve linearization and differentiated gain for positive and negative regulation

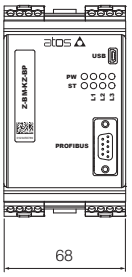
12.6 Motion phases parameters

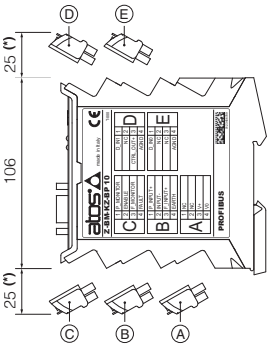
When the internal reference generation is active a pre-programmed cycle can be generated; start/stop/switch-over commands and reference generation types parameters can be set to design a customized sequence of motion phases adapted to the specific application requirements (see 4.2).

13 OVERALL DIMENSIONS [mm]

overall dimension with assembled connectors







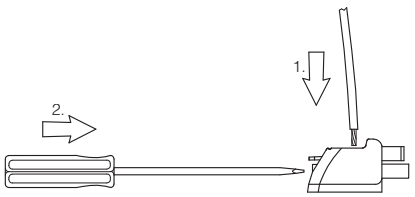
DIN rail dimensions

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

(*) Space to remove the connectors

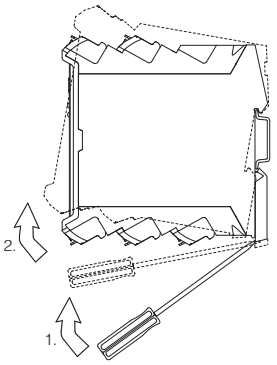
14 INSTALLATION

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 controller from the DIN rail:
1. pull down the locking slide with a screwdriver
2. rotate up the controller



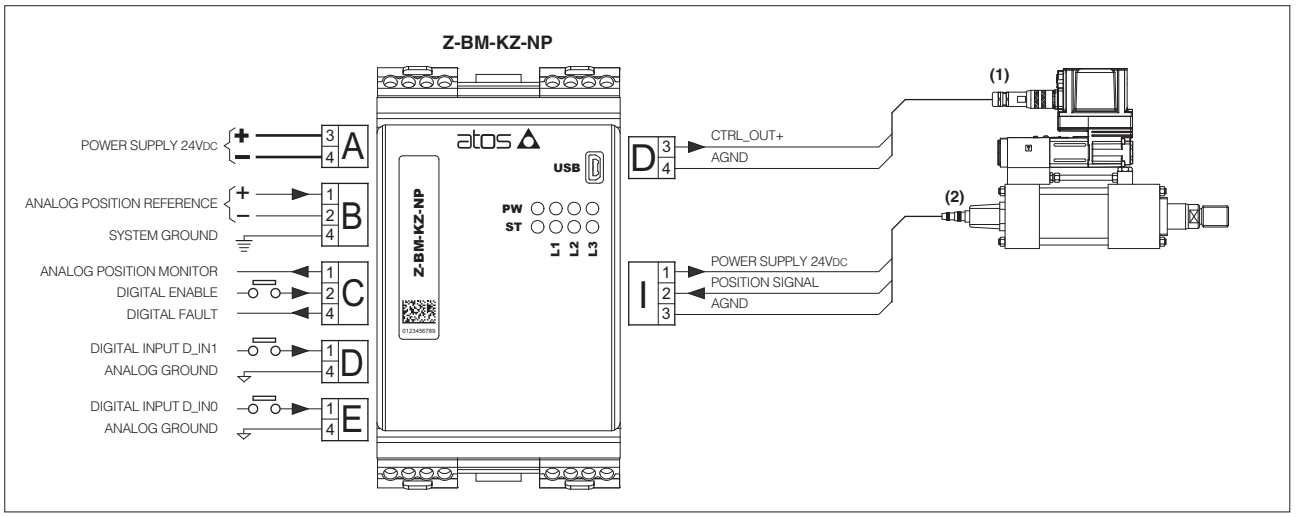
To extract the connectors:
1. push lever
2. pull connector

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)

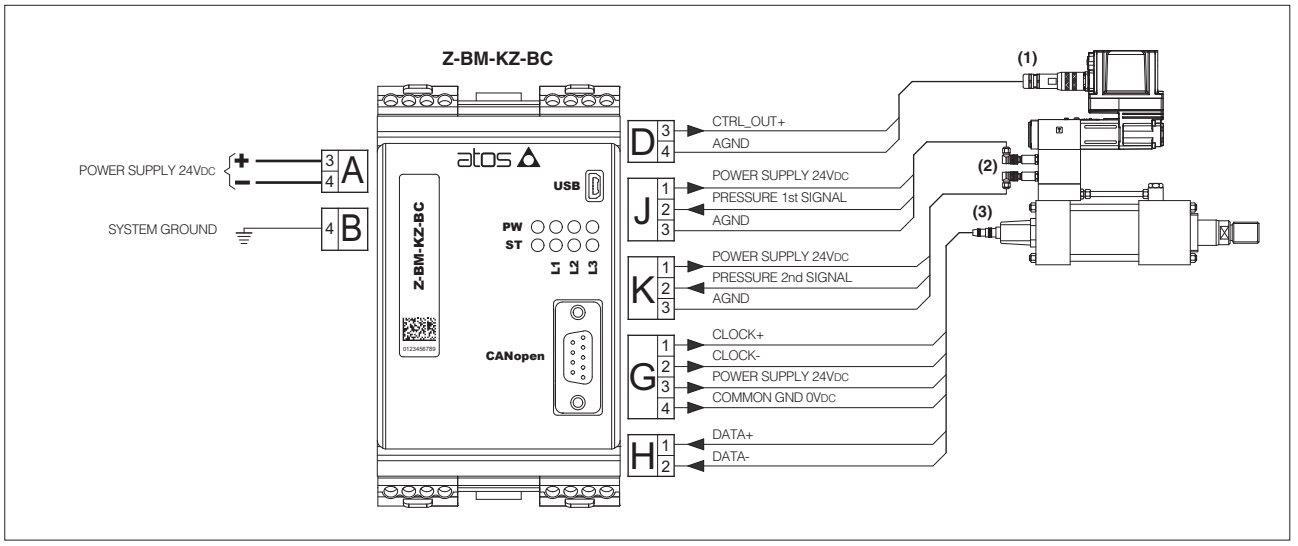
15 WIRING EXAMPLES

15.1 Position control - analog reference - analog position transducer



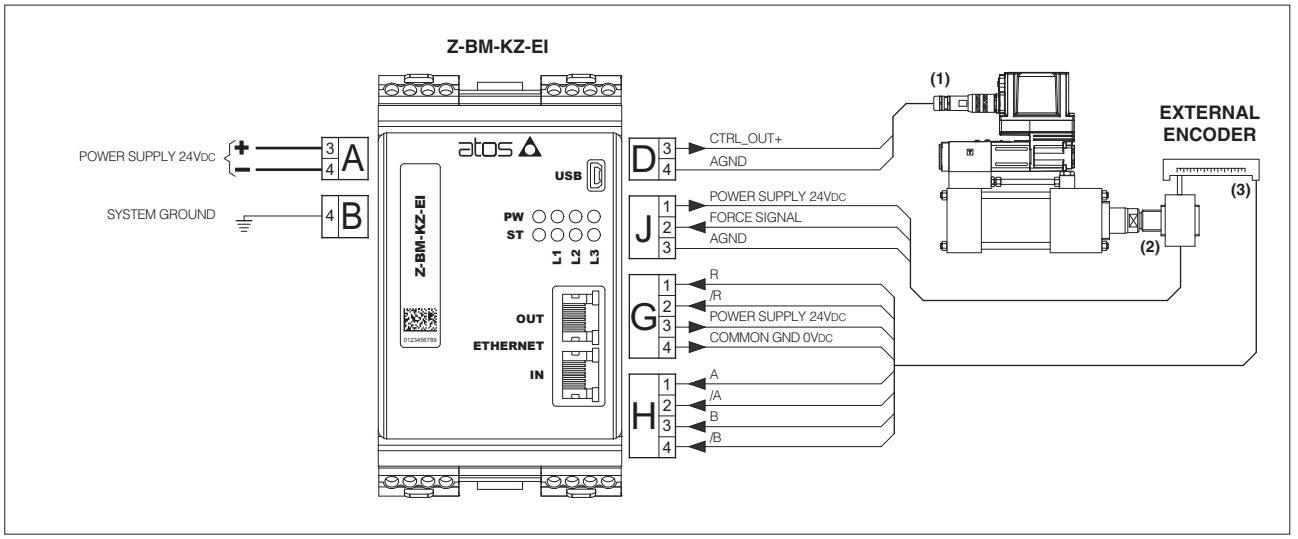
(1) For valve driver electrical connections please refer to the specific technical table
(2) The analog position transducer connections are intended as generic example, for details please consult the transducer's datasheet

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's datasheet

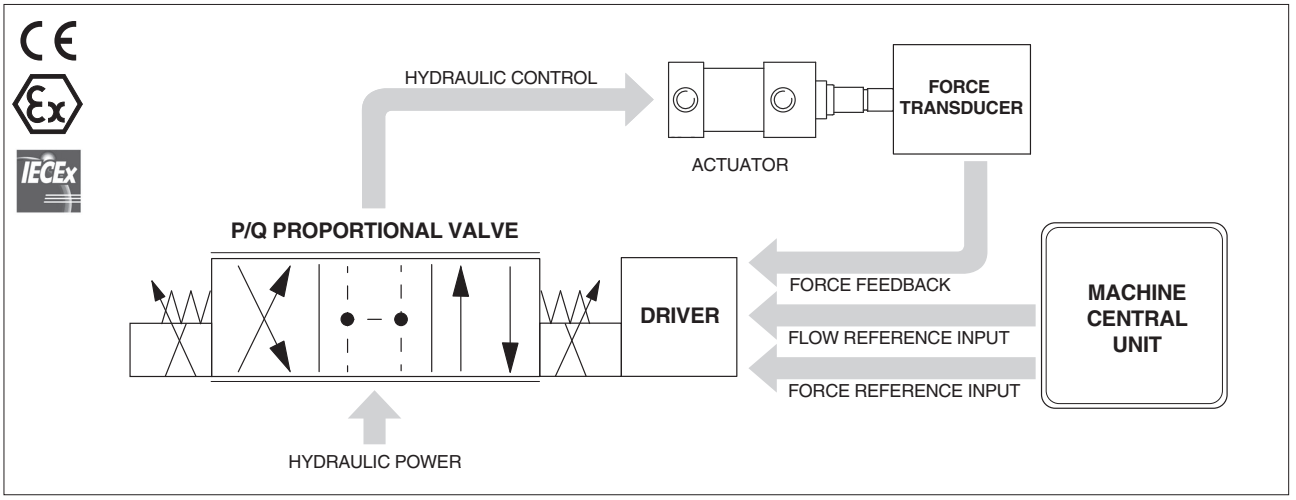
15.3 Alternated position/force control - EtherNet/IP reference - Encoder position transducer - analog load cell



(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's datasheet

Ex-proof digital proportional valves with P/Q control

directional valves with LVDT transducer and on board driver



1 GENERAL DESCRIPTION

The ex-proof 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 ex-proof high performance proportional directional valves and ex-proof servoproportional valves with TES/LES on-board digital driver or TEZ/LEZ axis controller.
Valve’s performance characteristics and overall dimensions remains unchanged as per specific FX** technical tables.

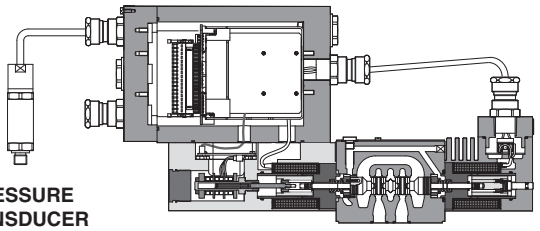
Servoproportionals:
DLHZA-TES, DLKZA-TES - direct, zero spool overlap, sleeve execution - technical tables **FX150**
DHZA-TES, DKZA-TES - direct, zero spool overlap - technical tables **FX135**
DPZA-LES - piloted, zero spool overlap - technical table **FX235**
LIQZA-LES - 3-way servocartridges - technical table **FX380**

Servoproportionals with TEZ/LEZ axis controller:
DLHZA-TEZ, DLKZA-TEZ - direct, zero spool overlap, sleeve execution - technical tables **FX610**
DHZA-TEZ, DKZA-TEZ - direct, zero spool overlap - technical tables **FX620**
DPZA-LEZ - piloted, zero spool overlap - technical tables **FX630**

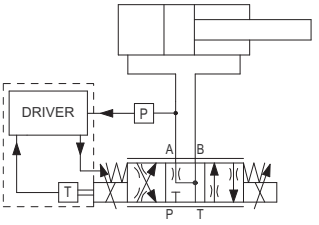
High perfomance proportionals:
DHZA-TES, DKZA-TES - direct, positive spool overlap - technical table **FX130**
DPZA-LES - piloted, positive spool overlap - technical table **FX230**

4 SP, SF, SL CONFIGURATION EXAMPLES

SP - Pressure Control - 1 pressure transducer

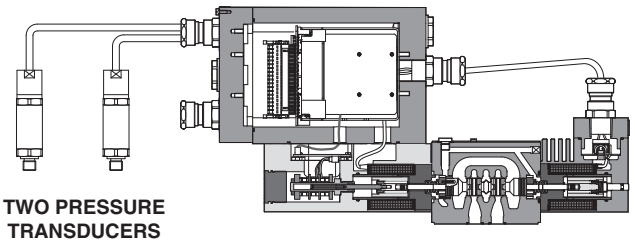


e.g. DHZA-TES- **SP**

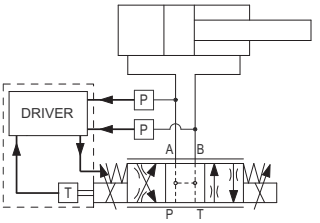


one remote pressure transducer has to be installed on the actuator's port to be controlled.
In this example the SP option regulates the pressure on port A

SF - Force Control - 2 pressure transducers

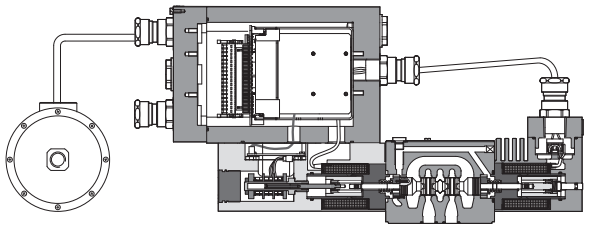


e.g. DHZA-TES- **SF**

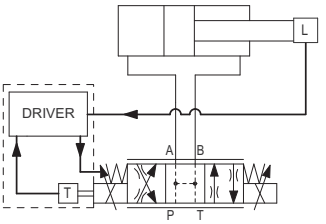


two remote pressure transducers have to be installed on the actuator's ports A and B.
The bore and rod dimensions of the actuator have to be input into the valve software, which calculates the relevant areas:
A1 = bore area; A2 = ring area
The SF option directly controls the actuator force (F) as result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

SL - Force Control - 1 load cell



e.g. DHZA-TES- **SL**



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 **F003** 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 **GS003**).
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)

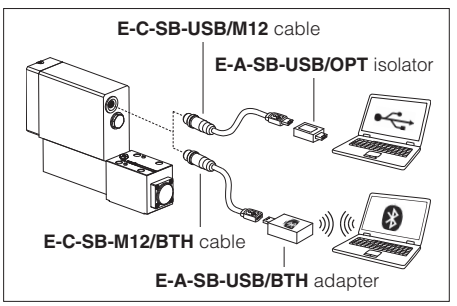
E-SW-FIELDBUS/PQ and **Z-SW-FULL** support:

NP (USB) - only Z-SW-FULL

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 ex-proof 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:

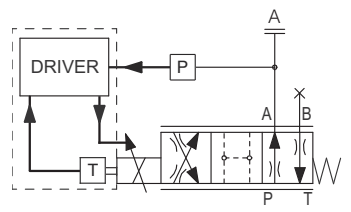
- flow reference signal is used to limit the maximum flow during the pressure regulation
- pressure reference signal is used to regulate the pressure on the valve's A user port; the rapid/repeatable response of the pressure control is performed in high dynamics by the directional valve's closed loop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

Requirements:

- an ex-proof 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:

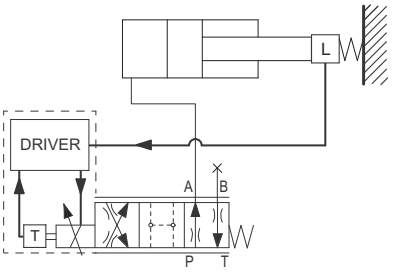
- flow reference signal is used to regulate the actuator's forward and backward speed while pressure (force) reference signal is used to limit the maximum pushing pressure (force) to the actuator
  or
- pressure (force) reference signal is used to regulate the actuator pushing pressure (force) while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

Requirements:

- for SP control a remote ex-proof 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:

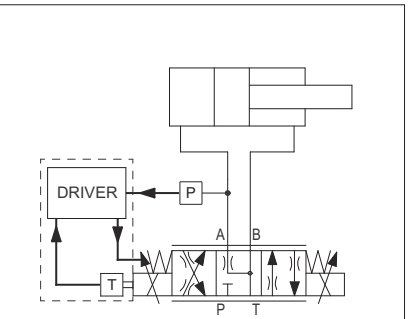
- flow reference signal is used to regulate the actuator's forward and backward speed while pressure reference signal is used to limit the maximum pushing pressure of the actuator
  or
- pressure reference signal is used to regulate the actuator pushing pressure while flow reference signal is used to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

Requirements:

- an ex-proof 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**

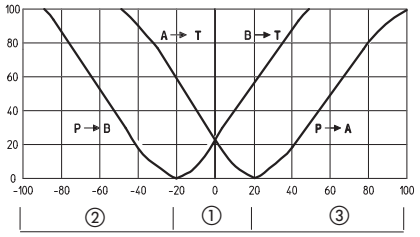


4 way connection SP

7.4 Q5 spool for 4 way connection with SP control

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 ex-proof remote pressure transducers have to be installed on the both actuator's ports
- for SL one ex-proof 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

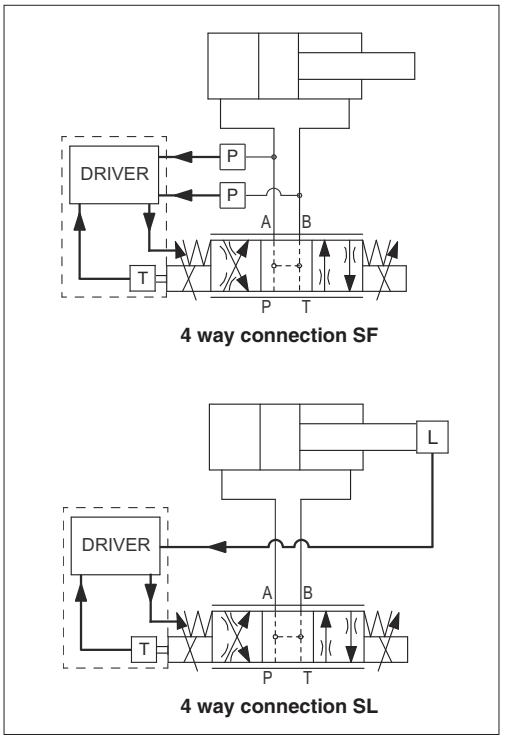
Advantages:

- 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 ex-proof 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

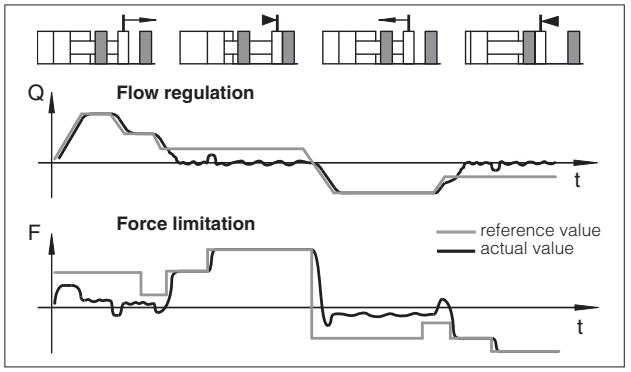
Double effect - only for **SF** or **SL**



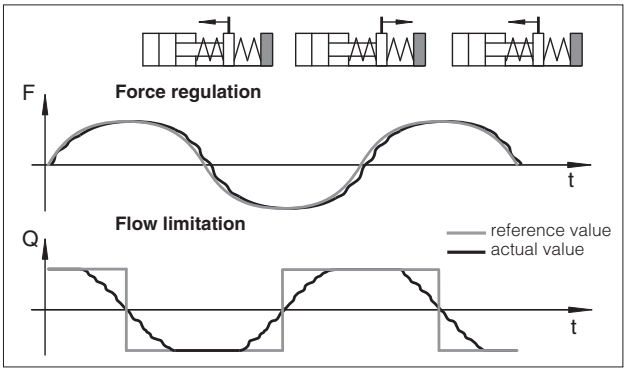
Notes:

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 **GX800** for E-ATRA-7 ex-proof 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
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www.atos.nt-rt.ru ‖ aoy@nt-rt.ru