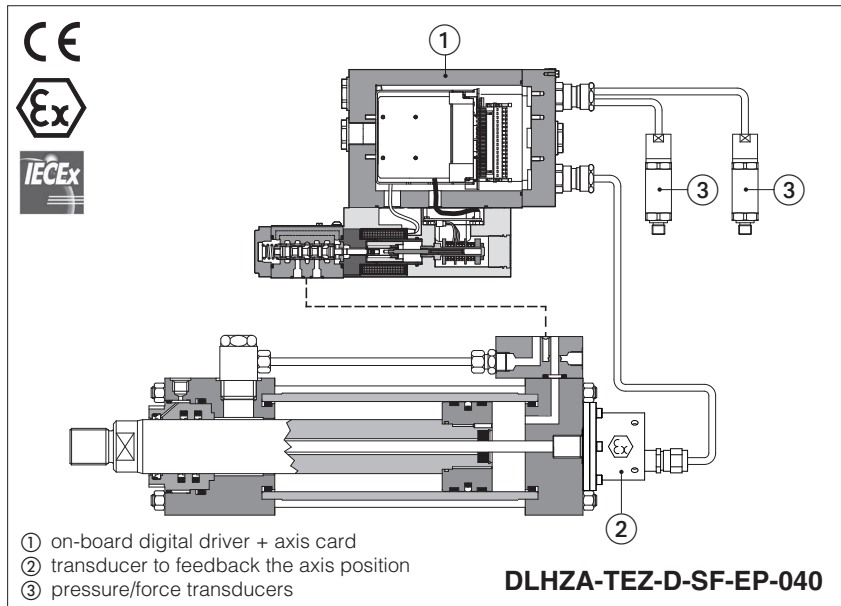# Ex-proof digital servoproportionals **with on-board axis card**

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:	**DLKZA**:
Size: **06** -ISO 4401	Size: **10** -ISO 4401
Max flow: **50 l/min**	Max flow: **100 l/min**
Max pressure: **350 bar**	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   **EW** = POWERLINK
BP = PROFIBUS DP   **EI** = EtherNet/IP
EH = EtherCAT   **EP** = PROFINET RT/IRT

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

Configuration: Standard   Option **/B**

40 =
with fail safe configuration 1 or 3

60 =
without fail safe

Spool type, regulating characteristics:

L = linear   **V** = progressive   **T** = not linear **(1)**

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

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

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

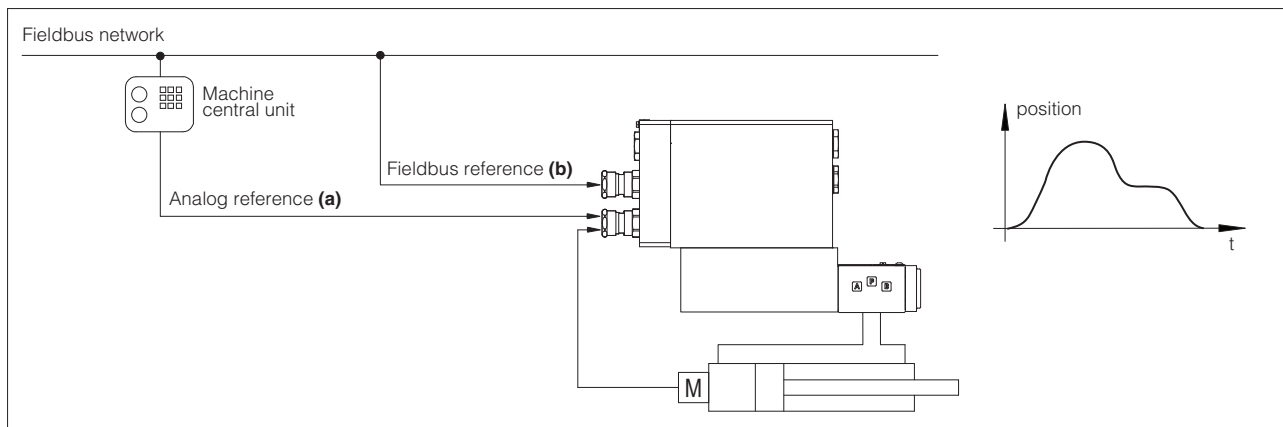### 2.1 External reference generation

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.
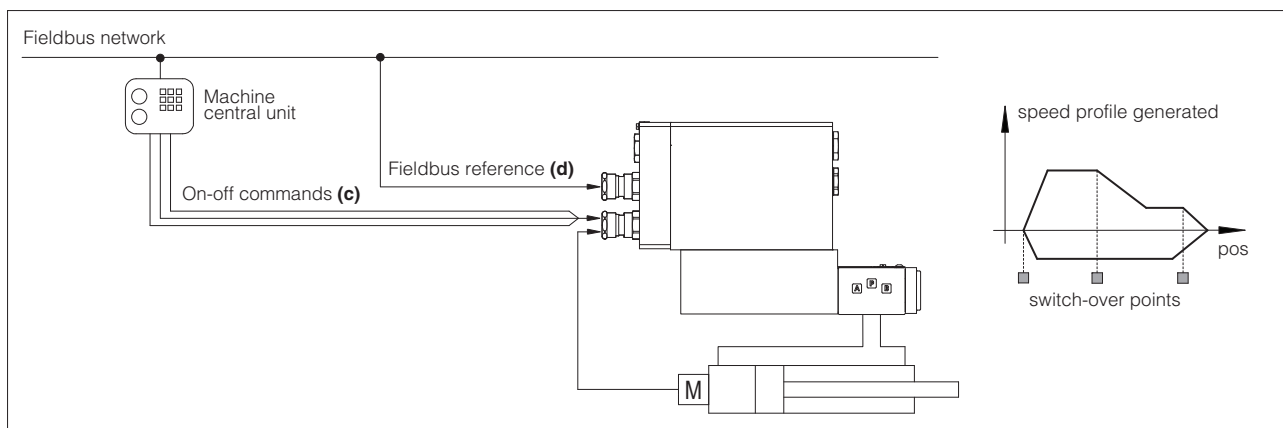
Start / stop / switch-over commands examples

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
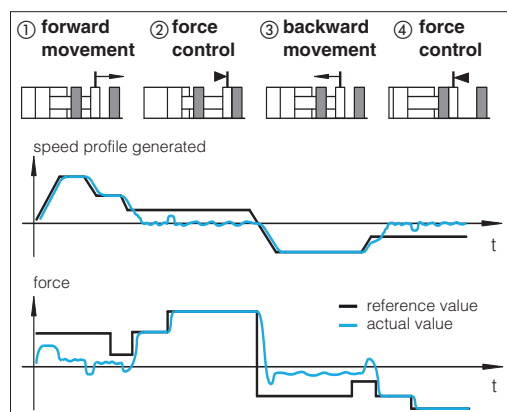
3 ALTERNATED POSITION / FORCE CONTROL

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.

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

speed profile generated

force

— reference value
— actual value

Alternated control configurations

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

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

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

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

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

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**

USB or Bluetooth connection

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.

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

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

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

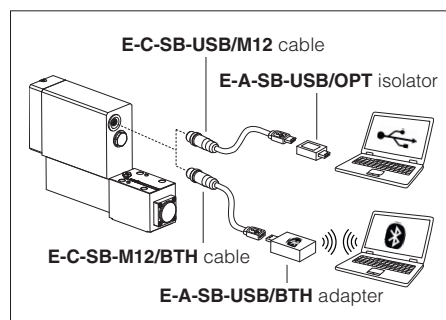**Note:** Z-SW programming software supports valves with option SF, SL for alternated control

⚠ **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**)

⚠ **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]	at Δp = 30 bar	2,5	4,5	8	9	13	18		26			26÷13		40		60			60÷33	
Δp P-T	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

Power supplies	Nominal : +24 V_{DC} Rectified and filtered : V_{RMS} = 20 ÷ 32 V_{MAX} (ripple max 10 % V_{PP})
Max power consumption	35 W
Analog input signals	Voltage: range ±10 V_{DC} (24 V_{MAX} tollerant) Input impedance: R_i > 50 kΩ Current: range ±20 mA Input impedance: R_i = 500 Ω
Monitor outputs	Output range: voltage ±10 V_{DC} @ max 5 mA current ±20 mA @ max 500 Ω load resistance
Enable input	Range: 0 ÷ 5 V_{DC} (OFF state), 9 ÷ 24 V_{DC} (ON state), 5 ÷ 9 V_{DC} (not accepted); Input impedance: R_i > 10 kΩ
Fault output	Output range: 0 ÷ 24 V_{DC} (ON state > [power supply - 2 V] ; OFF state < 1 V) @ max 50 mA; external negative voltage not allowed (e.g. due to inductive loads)
Position transducers power supply	+24 V_{DC} @ max 100 mA and +5 V_{DC} @ max 100 mA are software selectable; ±10 V_{DC} @ max 14 mA minimum load resistance 700 Ω
Pressure/Force transducer power supply (only for SF, SL)	+24V_{DC} @ max 100 mA (E-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 V_{DC} power supply and when the valve is ready to operate. During this time the current to the valve coils is switched to zero.

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 longer life	ISO4406 class 18/16/13 NAS1638 class 7 ISO4406 class 16/14/11 NAS1638 class 5		see also filter section at www.atos.com or KTF catalog
Hydraulic fluid	**Suitable seals type**	**Classification**	**Ref. Standard**
Mineral oils	NBR, FKM, HNBR	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water	NBR, HNBR	HFC	ISO 12922

⚠ 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 www.atos.com
(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.
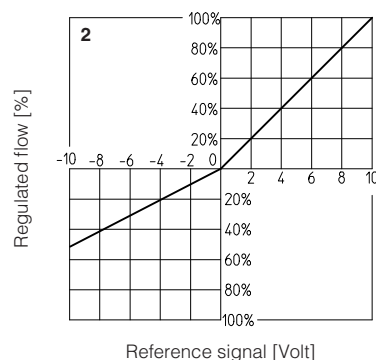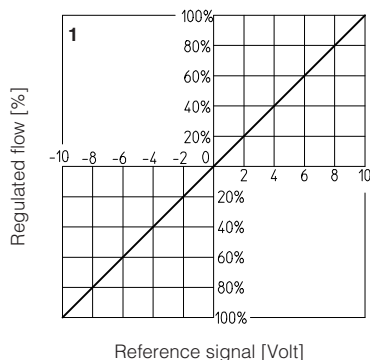
16 **POSSIBLE COMBINED OPTIONS**

For SN: /BI, /BY, /IY

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

17.1 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
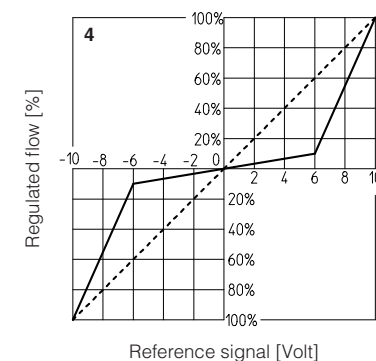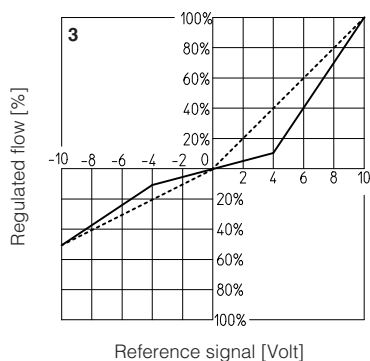
Note:
Hydraulic configuration vs. reference signal:

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

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

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

Reference signal $\left.\begin{array}{l} 0 \div -10 \text{ V} \\ 12 \div 4 \text{ mA} \end{array}\right\} P \rightarrow A / B \rightarrow T$
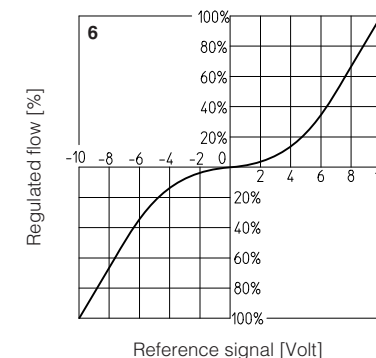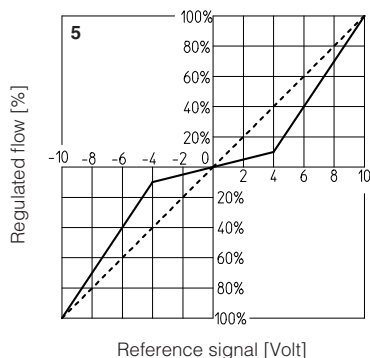
17.2 Pressure gain
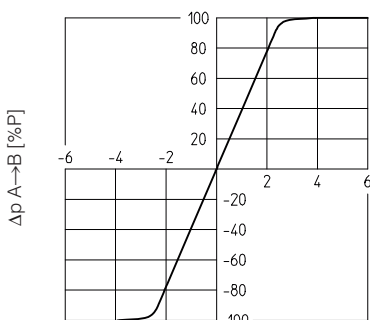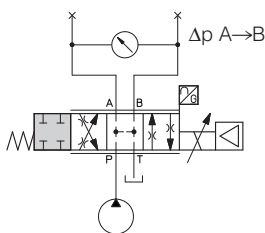
17.3 Bode diagrams
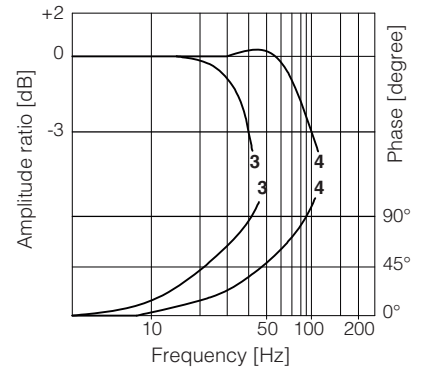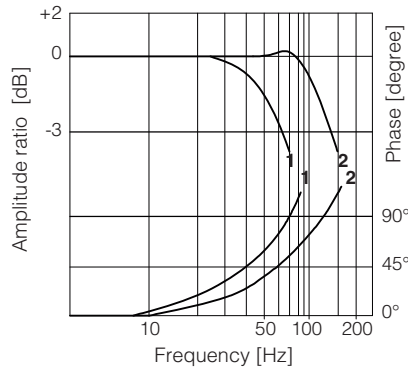Stated at nominal hydraulic conditions

DLHZA:
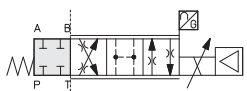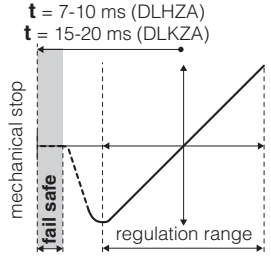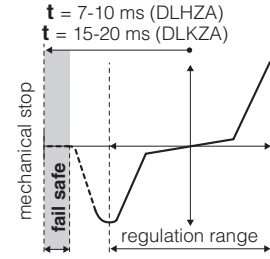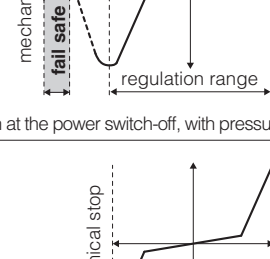**1** = ± 100% nominal stroke
2 = ± 5% nominal stroke
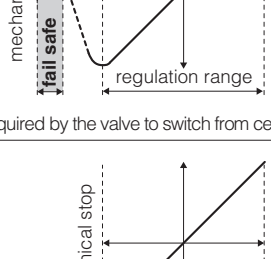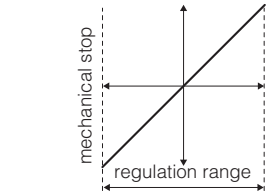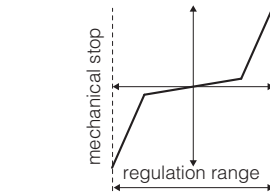
DLKZA:
3 = ± 100% nominal stroke
4 = ± 5% nominal stroke

| 18 | **FAIL SAFE POSITION** |

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

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

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FX610

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 V$_{DC}$	+24 V$_{DC}$	+5 V$_{DC}$ / +24 V$_{DC}$	+5 V$_{DC}$ / +24 V$_{DC}$	+24 V$_{DC}$
Controller Interface	±10V	0 ÷ 10V 4 ÷ 20 mA	Serial SSI binary/gray	TTL 5Vpp - 150 KHz	±10 V$_{DC}$ 4 ÷ 20 mA
Max speed	0,5 m/s	1 m/s	2 m/s	2 m/s	-
Max Resolution	< 0.4 % FS	< 0.2 % FS	1 μm	1 μm (@ 0.15 m/s)	< 0.4 % FS
Linearity error **(2)**	± 0.1% FS	< ±0.03% FS	< ± 0.01 % FS	< ± 0.001 % FS	< ±0.25% FS
Repeatability **(2)**	± 0.05% FS	< ± 0.005% FS	< ± 0.001 % FS	< ± 0.001 % FS	< ±0.1% FS

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

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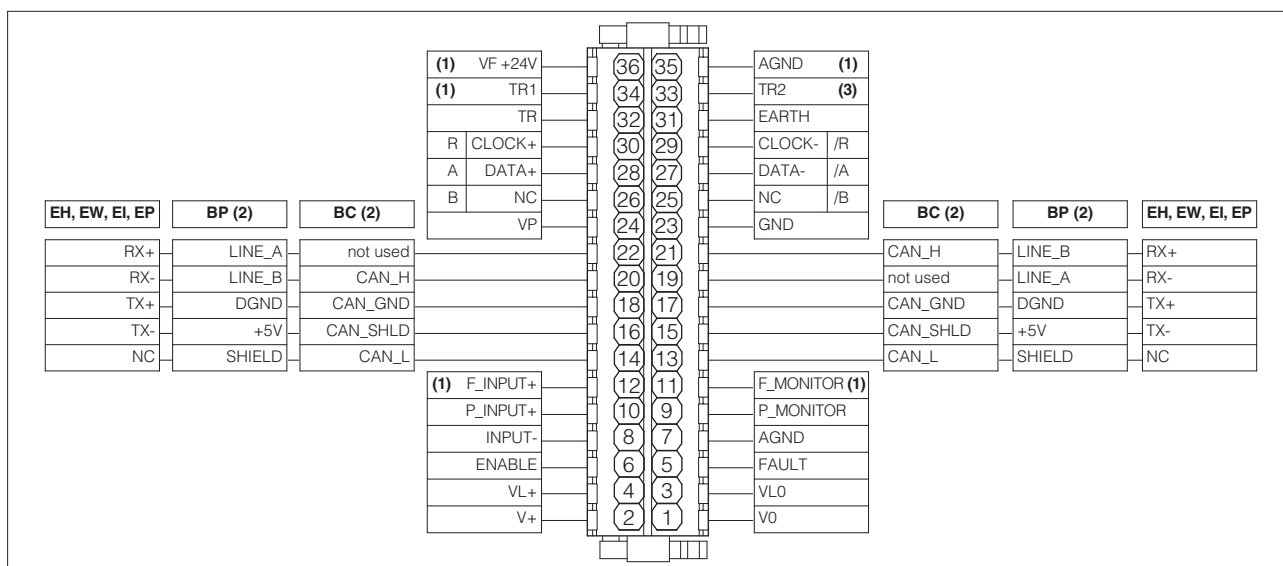
(1) Connections available only for **SF**, **SL**
(2) For BC and BP executions the fieldbus connections have an internal pass-through connection
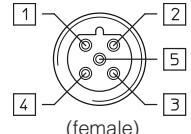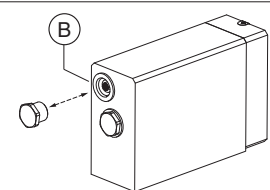**(3)** Connection available only for **SF**

22.1 Main connections signals

CABLE ENTRANCE	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
A	1	V0	Power supply 0 V$_{DC}$	Gnd - power supply
	2	V+	Power supply 24 V$_{DC}$	Input - power supply
	3	VL0	Power supply 0 V$_{DC}$ for driver's logic and communication	Gnd - power supply
	4	VL+	Power supply 24 V$_{DC}$ for driver's logic and communication	Input - power supply
	5	FAULT	Fault (0 V$_{DC}$) or normal working (24 V$_{DC}$), referred to VL0	Output - on/off signal
	6	ENABLE	Enable (24 V$_{DC}$) or disable (0 V$_{DC}$) 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 V$_{DC}$ / ±20 mA maximum range, referred to AGND Defaults are: ±10 V$_{DC}$ for standard and 4 ÷ 20 mA for /I option	Output - analog signal **Software selectable**
	10	P_INPUT+	Position reference input signal: ±10 V$_{DC}$ / ±20 mA maximum range Defaults are: ±10 V$_{DC}$ 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 V$_{DC}$ / ±20mA maximum range, referred to AGND Defaults are: ±10 V$_{DC}$ 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 V$_{DC}$ / ±20 mA max. range Defaults are: ±10 V$_{DC}$ 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 +

Driver view

1 2
5
4 3

(female)

B

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	Current	SF - Double transducers (1) Voltage	Current
D1 D2	33	TR2	2nd signal transducer ±10 V$_{DC}$ / ±20 mA maximum range	Input - analog signal **Software selectable**	/	/	Connect	Connect
	34	TR1	1st signal transducer ±10 V$_{DC}$ / ±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 +24V$_{DC}$	Output - power supply	Connect	Connect	Connect	Connect

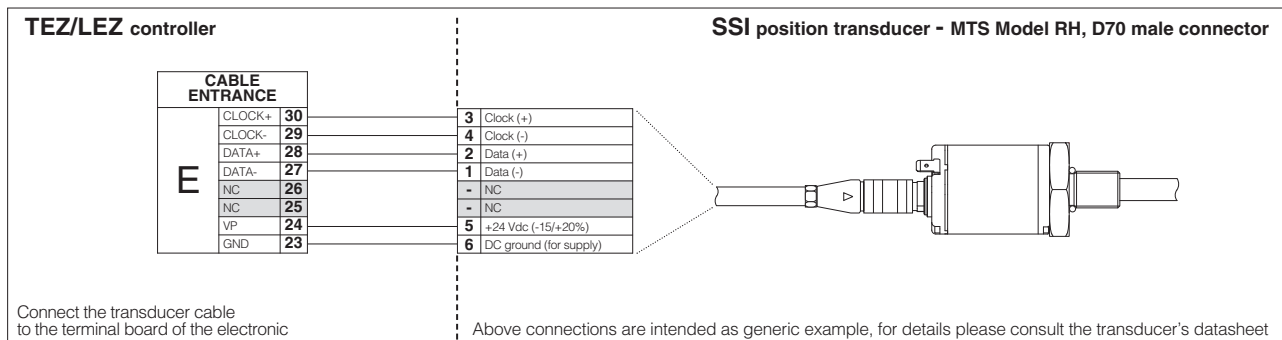**E-ATRA remote pressure transducer connection** - see tech table **GX800**

for **SF** option

CABLE ENTRANCE		Current signal		E-ATRA pressure transducer
D1	VF +24V **36**	**RED**	V+	
	TR1 **34**	**BLACK**	Vout	
		GRAY	SHIELD	
		BROWN	do not connect	

CABLE ENTRANCE		Current signal		E-ATRA pressure transducer
D2	VF +24V **36**	**RED**	V+	
	TR2 **33**	**BLACK**	Vout	
		GRAY	SHIELD	
		BROWN	do not connect	

Connect the transducers cables to the terminal board of the electronic
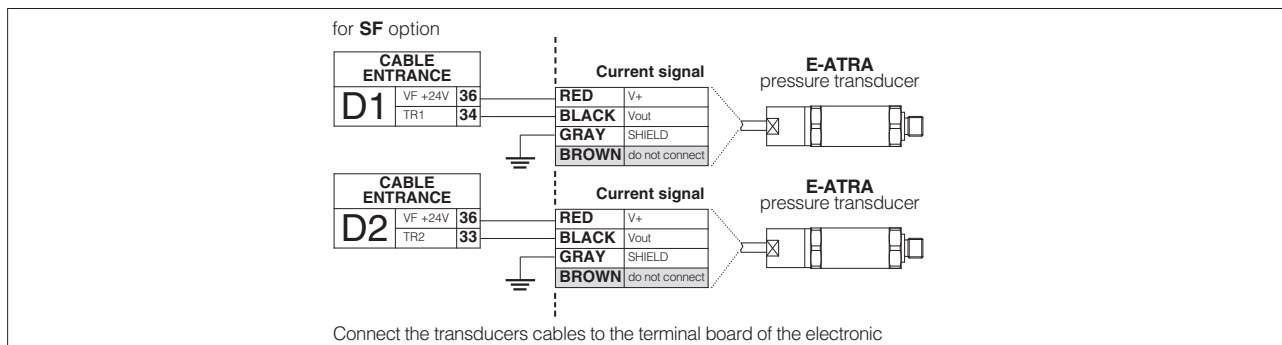
22.7 D execution - Digital position transducers connections

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
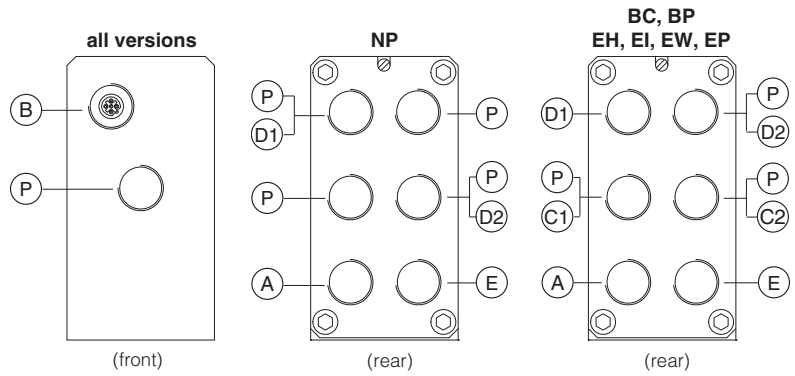
SSI connection - example

TEZ/LEZ controller

SSI position transducer **-** MTS Model RH, D70 male connector

CABLE ENTRANCE			
CLOCK+	**30**	**3**	Clock (+)
CLOCK-	**29**	**4**	Clock (-)
DATA+	**28**	**2**	Data (+)
DATA-	**27**	**1**	Data (-)
NC	**26**	**-**	NC
NC	**25**	**-**	NC
VP	**24**	**5**	+24 Vdc (-15/+20%)
GND	**23**	**6**	DC ground (for supply)

Connect the transducer cable to the terminal board of the electronic

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

Encoder connection - example

TEZ/LEZ controller

Encoder - HEIDENHAN Model LS 100, cable gland

CABLE ENTRANCE			
R	**30**	**Red**	R+
/R	**29**	**Black**	R-
A	**28**	**Brown**	A+
/A	**27**	**Green**	A-
B	**26**	**Gray**	B+
/B	**25**	**Pink**	B-
VP	**24**	**Brown / Green**	Up
GND	**23**	**White / Green**	0V

Connect the transducer cable to the terminal board of the electronic

Above connections are intended as generic example, for details please consult the transducer's datasheet
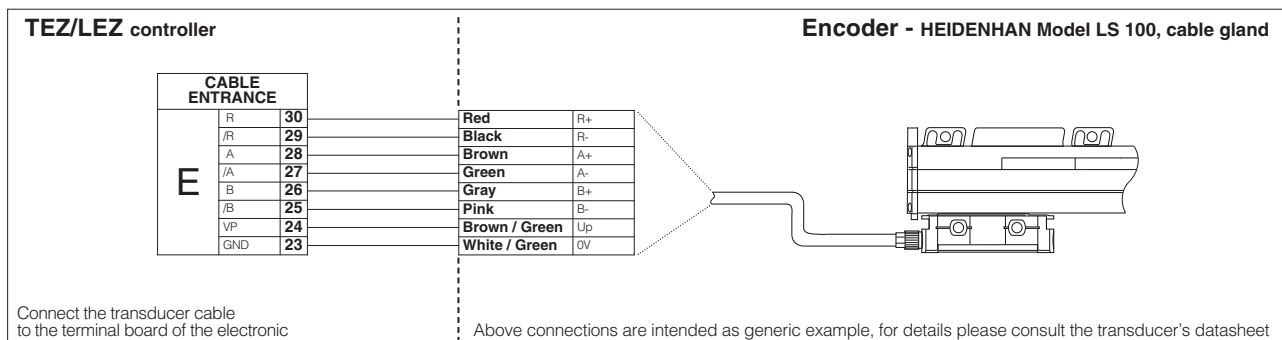
22.8 A execution - Analog position transducers connector

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

CABLE ENTRANCE OVERVIEW

**Cables entrance description:**

Ⓐ main connections
Ⓑ USB connector always present (factory plugged)
Ⓒ1 fieldbus (input)
Ⓒ2 fieldbus (output)
Ⓓ1 pressure transducer 1
Ⓓ2 pressure transducer 2
Ⓔ position transducer
Ⓟ threaded plug

all versions
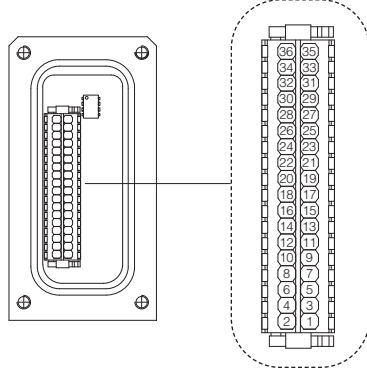
NP

**BC, BP
EH, EI, EW, EP**

(front)

(rear)

(rear)

TERMINAL BOARD AND FIELDBUS TERMINATOR

FRONT

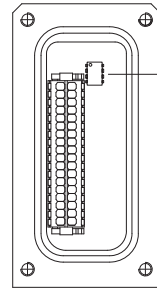Remove the 4 screws of driver's rear cover to access terminal board and fieldbus terminator

5

n°4 M6
Tightening torque **15 Nm**

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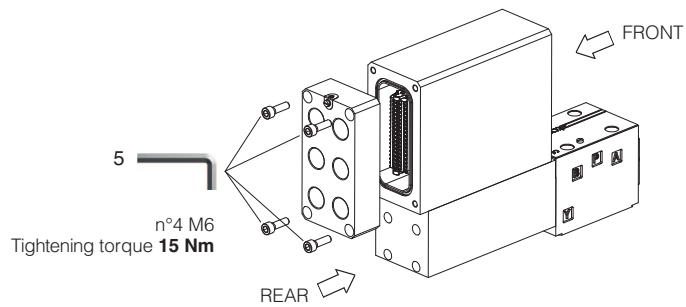
⚠ **WARNING:** the above operation must be performed in a safety area

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

USB

E-C-SB-USB/M12
USB CABLE
cable lenght 4m

male **(2)**

DO NOT REMOVE
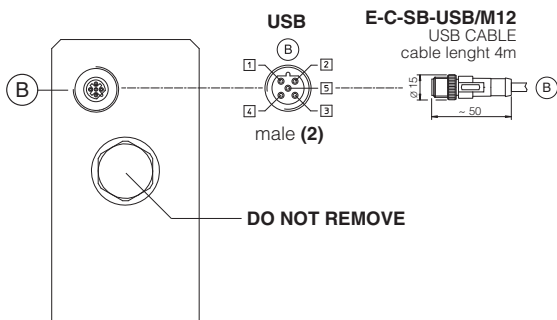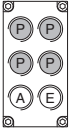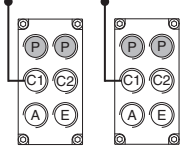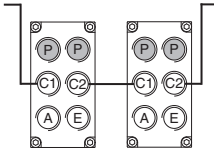
METALLIC PROTECTION CAP - supplied with the valves

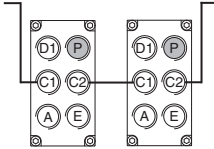24

Tightening torque: **20 Nm**

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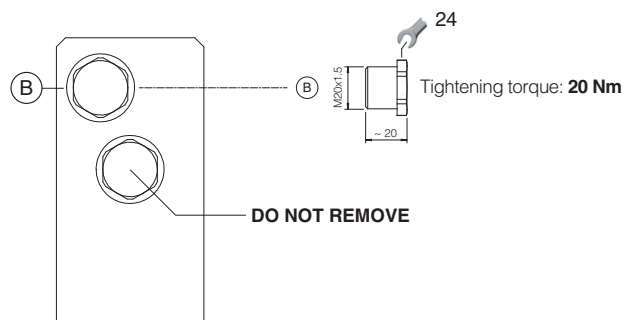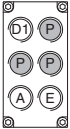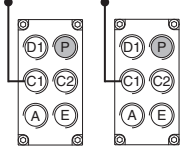
(1) Drivers with BC and BP fieldbus interface are delivered by default 'Not Terminated'. All switches are set OFF
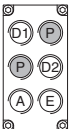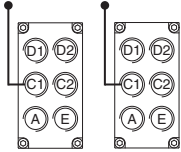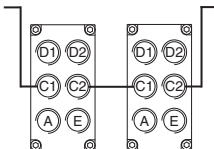**(2)** Pin layout always referred to driver's view

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

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)

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FX610

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)

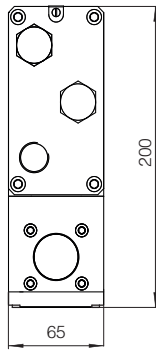| Mass [kg]	
DLHZA-TEZ	7,2
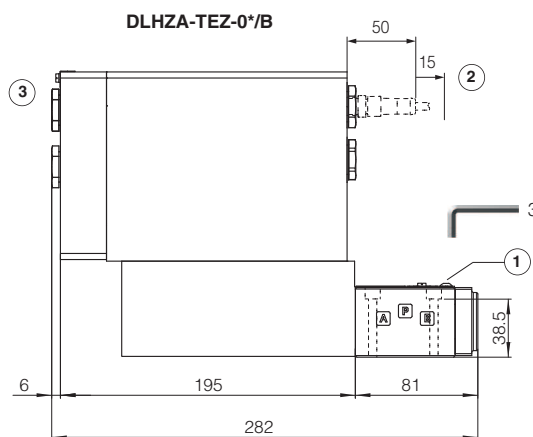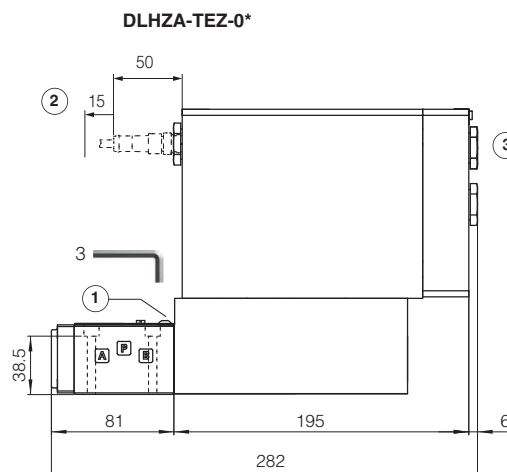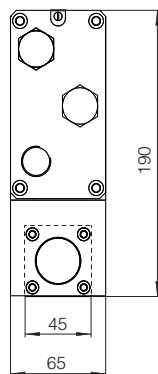
DLHZA-TEZ-0*

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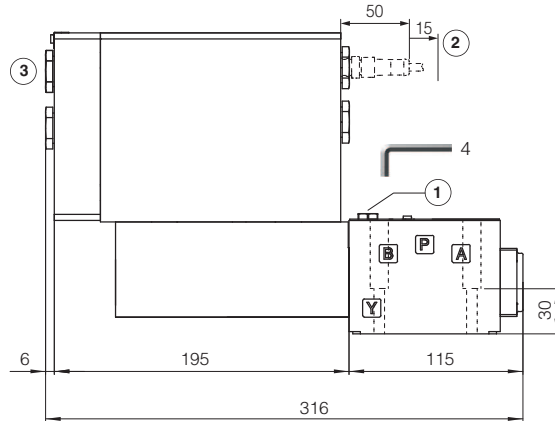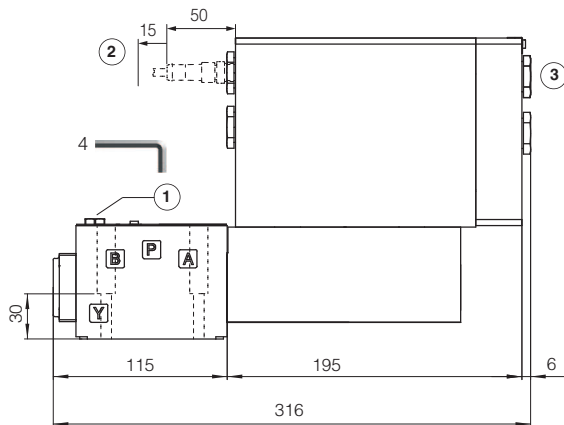
ISO 4401: 2000
Mounting surface: 4401-05-04-0-05 (see table P005)
(for /Y surface 4401-05-05-0-05 without X port)

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**)