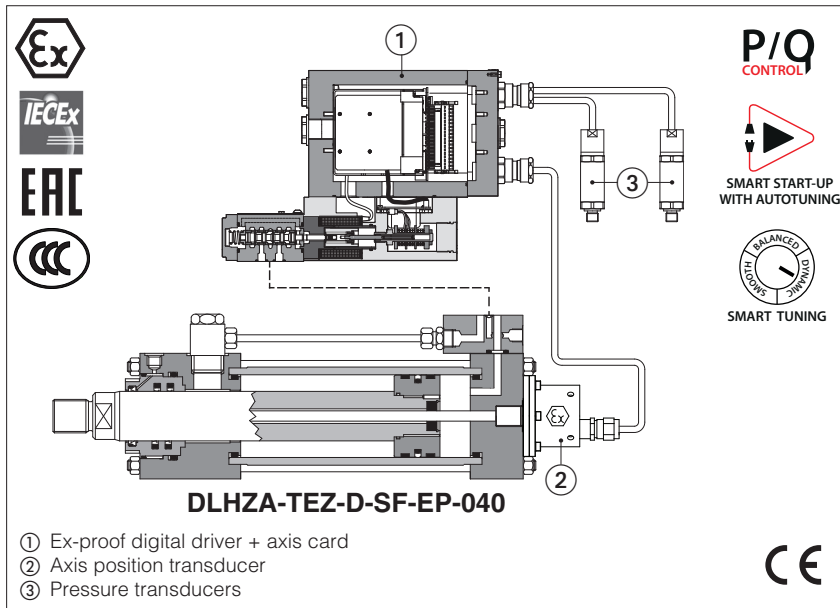# Ex-proof digital servoproportionals with on-board axis card

direct, single solenoid, sleeve execution, with LVDT transducer, zero spool overlap - **ATEX, IECEx, EAC, CCC**

DLHZA-TEZ-D-SF-EP-040

① Ex-proof digital driver + axis card
② Axis position transducer
③ Pressure transducers

SMART START-UP WITH AUTOTUNING

SMART TUNING

P/Q CONTROL

DLHZA-TEZ, DLKZA-TEZ

Ex-proof digital servoproportional directional valves, single solenoid, sleeve execution, with on-board digital driver + axis card, LVDT position transducer and zero spool overlap for best performances in any position closed loop controls of linear or rotative hydraulic actuator.
They are certified for safe operations in hazardous environments with potentially explosive atmosphere.

• Multicertification **ATEX**, **IECEx**, **EAC**, **CCC** for gas group **II 2G** and dust category **II 2D**

The controlled actuator has to be equipped with position transducer (analog, potentiometer, SSI or Encoder) to read the axis position feedback.
Optional alternated P/Q control add the force limitation to position regulation, requiring pressure or force transducers installation.
Smart Start-up procedure makes the commissioning quicker and easier, thanks to the Autotuning and Smart Tuning functionalities. Multiple PID sets allows to easily switch axis behaviour according to machine cycle.

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

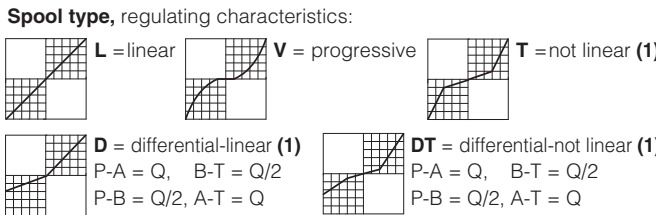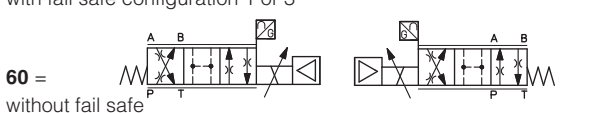**Position transducer type**:
A = Analog (standard, potentiometer)
D = Digital (SSI, Encoder)

Alternated P/Q controls, see section **3** :
SN = none
SF = force control (2 pressure transducers)
SL = force control (1 load cell)

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

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

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

40 =
with fail safe configuration 1 or 3

60 =
without fail safe

Spool type, regulating characteristics:

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

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

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

Seals material,
see section **13** :
-   = NBR
PE = FKM
BT = NBR low temp.

Series number

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

Electronic options (2):
C = current feedback for analog position and pressure transducer 4 ÷ 20 mA
I = current reference input and monitor 4 ÷ 20 mA

Cable entrance threaded connection:
M = M20x1,5

Fail safe configuration, see section **21** :

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 **19**

2 | POSITION CONTROL

### 2.1 External reference signal

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

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

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

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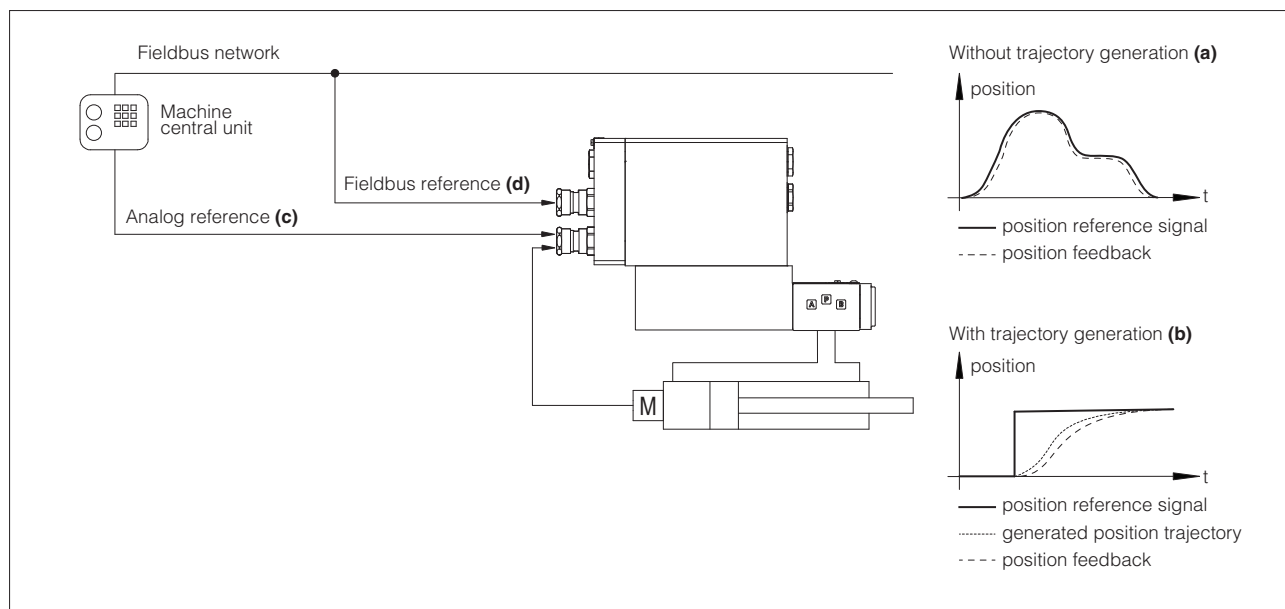
2.2 Automatic cycle

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

Atos PC software allows to realize an automatic cycle according to the application requirements. Refer to the axis card user manual for further details on automatic cycle features.
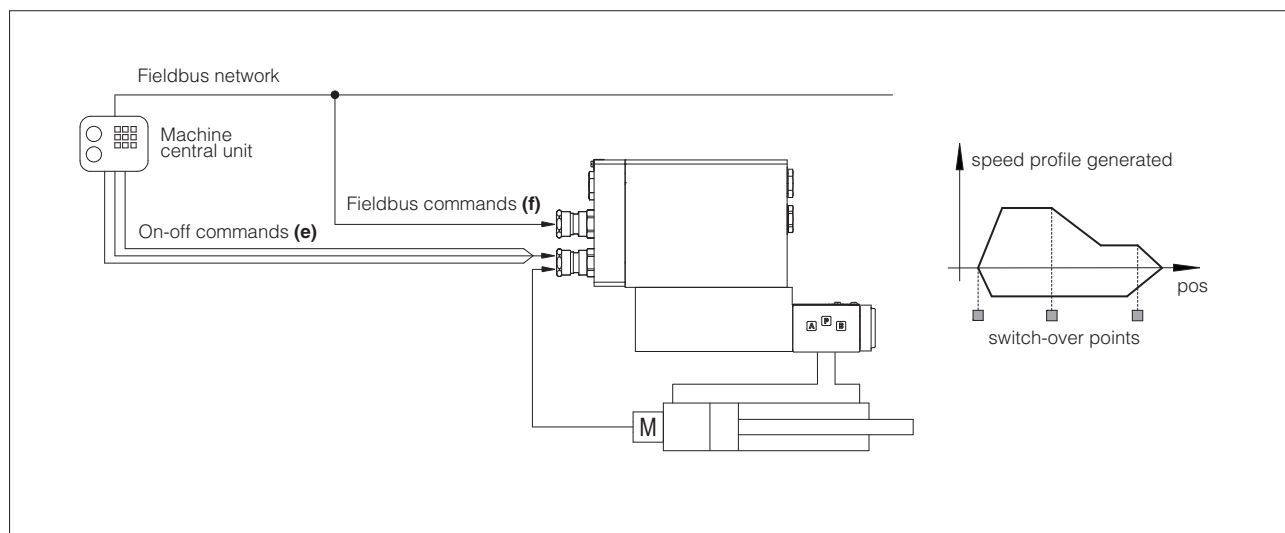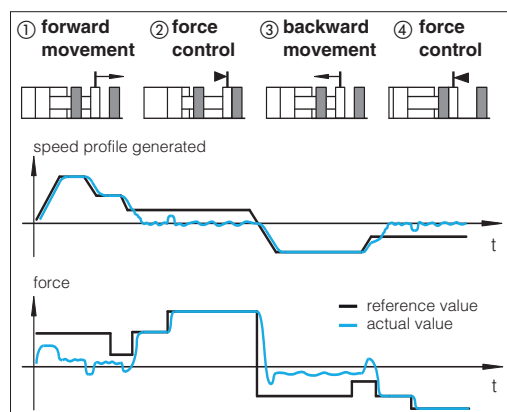
SF and **SL** controls add the alternated force closed loop control to the actuator standard position control. Pressure or force remote transducers have to be installed on the actuator and interfaced to the valve, see below functional schemes.

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

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

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

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

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

speed profile generated

force

— reference value
— actual value

Alternated control configurations

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

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

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

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

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

4 GENERAL NOTES

Atos digital proportionals valves are CE marked according to the applicable directives (e.g. Immunity and Emission EMC Directive).
Installation, wirings and start-up procedures must be performed according to the general prescriptions shown in tech table **FX900** and in the user manuals included in the Z-SW-* programming software.

5 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 Z-SW programming software connected via USB/Bluetooth to the axis card.
For fieldbus versions, the software permits valve's parameterization through USB/Bluetooth also if the axis card is connected to the central machine unit via fieldbus.

Z-SW-FULL support:

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

Note: Z-SW programming software supports valves with option SF, SL for alternated control
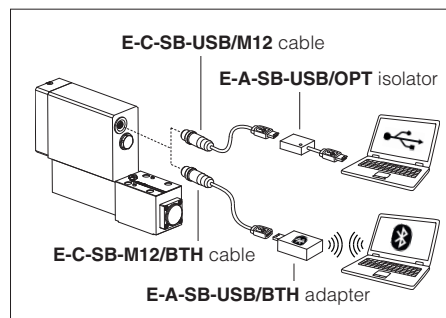
⚠ **WARNING: axis card USB port is not isolated!** For E-C-SB-USB/M12 cable, the use of isolator adapter is highly recommended for PC protection (see tech table **GS500**)

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

USB or Bluetooth connection

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

6 SMART START-UP

The automatic procedure supports the user during the commissioning phases of the axis control with guided procedures:

● **General setting**
It assists the user in system data setup, as like cylinder stroke, diameters, load mass, configure analog/digital signals and communication interface, position transducer setup.

● **System check**
It automatically executes position open loop movements to set axis control parameters, position transducer calibration and verify cylinder stroke.

● **Position autotuning**
It automatically determines the optimal PID parametrization of the position control adapting the dynamic response to guarantee control precision and axis stability. Once the procedure is started, the control performs few automatic position open loop movements of the actuator, during which control parameters are calculated and stored.

7 SMART TUNING

Once the Smart Start-up procedure has been completed, the Smart tuning feature allows to further refine the position control response by choosing from 3 different levels of performance in positioning:

- **dynamic**   best dynamics and accuracy (default factory setting)
- **balanced**   average dynamics and accuracy
- **smooth**   attenuated dynamics and accuracy to improve control stability in critical applications or in environments with electrical disturbances

Settings can be changed any time via Z-SW software or fieldbus.

If required, control performance can be further customized by modifying PID parameter via Z-SW software.
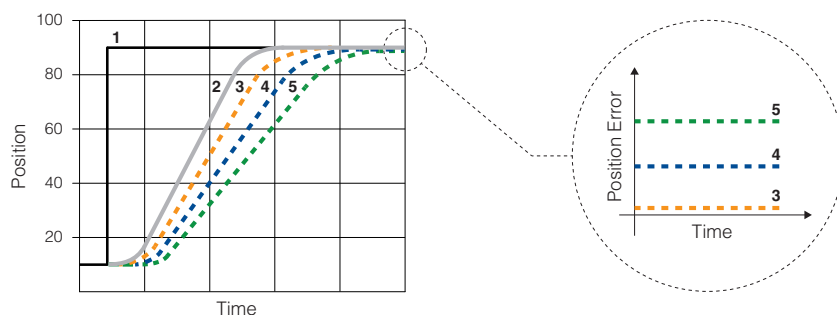
1 = position reference signal
2 = generated position trajectory
3 = dynamic
4 = balanced
5 = smooth

8 MULTIPLE SETS

Multiple PID sets allows to easily switch axis behaviour according to machine cycle, selecting between independent groups of parameters for:

- **position control PID**
- **force control PID and P/Q logics switching criteria**

Settings can be changed any time via Z-SW software, fieldbus or digital input signals.

9 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.

10 | 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, for further details 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
Corrosion resistance	Salt spray test (EN ISO 9227) > 200 h
Vibration resistance	See technical table GX004
Compliance	Explosion proof protection, see section 14 -Flame proof enclosure "Ex d" -Dust ignition protection by enclosure "Ex t" CE according to EMC directive 2014/30/EU (Immunity: EN 61000-6-2; Emission: EN 61000-6-3) RoHs Directive 2011/65/EU as last update by 2015/863/EU REACH Regulation (EC) n°1907/2006

11 | 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

12 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; protection against reverse polarity of power supply
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 axis card energizing with the 24 VDC power supply and when the valve is ready to operate. During this time the current to the valve coils is switched to zero.

13 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 NBR low temp. seals (/BT option) = -40°C ÷ +60°C, with HFC hydraulic fluids = -20°C ÷ +50°C		
Recommended viscosity	20÷100 mm²/s - max allowed range 15 ÷ 380 mm²/s		
Max fluid contamination level normal operation 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, NBR low temp.	HL, HLP, HLPD, HVLP, HVLPD	DIN 51524
Flame resistant without water	FKM	HFDU, HFDR	ISO 12922
Flame resistant with water **(1)**	NBR, NBR low temp.	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

14 CERTIFICATION DATA

Valve type	DLHZA, DLKZA		
Certifications	Multicertification Group II **ATEX IECEx EAC CCC**		
Solenoid certified code	**OZA-TEZ**		
Type examination certificate **(1)**	• ATEX: TUV IT 18 ATEX 068 X • IECEx: IECEx TPS 19.0004X	• EAC: RU C - IT.АЖ38.B.00425/21 • CCC: 2021322307004057	

Method of protection	• ATEX
	  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
		• EAC
		  1Ex d IIC T6/T5/T4 Gb X;
		  Ex tb IIIC T85°C/T100°C/T135°C Db X
		• CCC
		  Ex d IIC T6/T5/T4 Gb;
		  Ex tD A21 IP66/IP67 T85°C/T100°C/T135°C	

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: 2012+A11:2013 EN 60079-1:2014	EN 60079-31:2014 IEC 60079-0:2017 IEC 60079-1:2014	IEC 60079-31:2013
Cable entrance: threaded connection	**M** = M20x1,5		

(1) The type examination certificates can be downloaded from www.atos.com
(2) The driver 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**

15 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

15.1 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

16 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

17 HYDRAULIC OPTIONS

B = Solenoid, on-board digital driver + axis card and LVDT position transducer at side of port A of the main stage.
For hydraulic configuration vs reference signal, see 20.1

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

18 ELECTRONIC OPTIONS

I = This option 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 = This option is available to connect analog position transducer and 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.
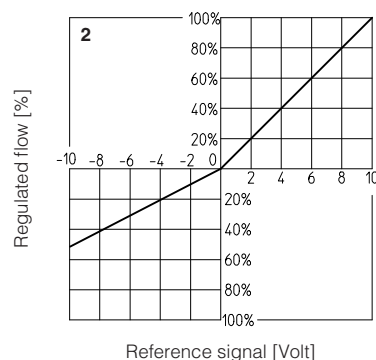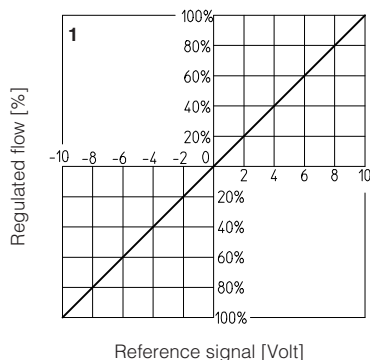
19 POSSIBLE COMBINED OPTIONS

For SN: /BI, /BY, /BIY, /IY

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

20.1 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 axis card, so the final valve regulation is resulting linear respect the reference signal (dotted line).

DT7 has the same characteristic of T7 but it is specific for applications with cylinders with area ratio 1:2
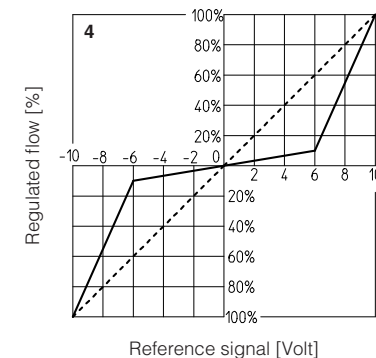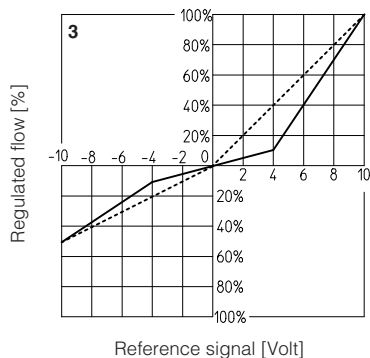
Note:
Hydraulic configuration vs. reference signal:

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

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

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

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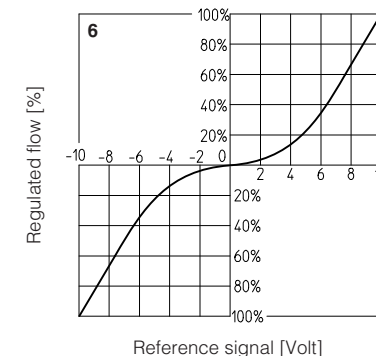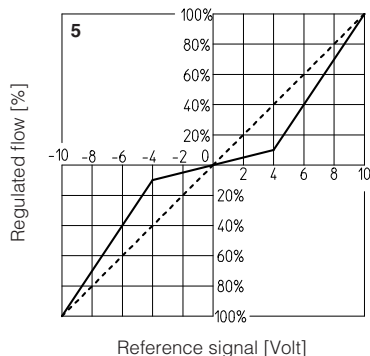
20.2 Pressure gain
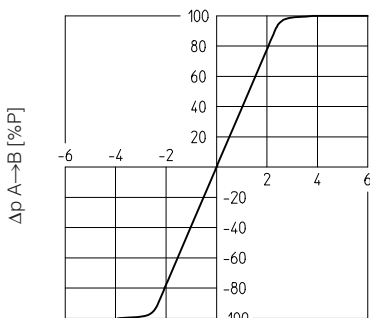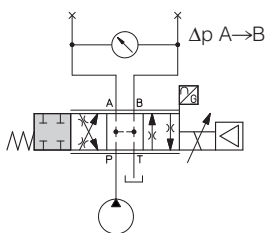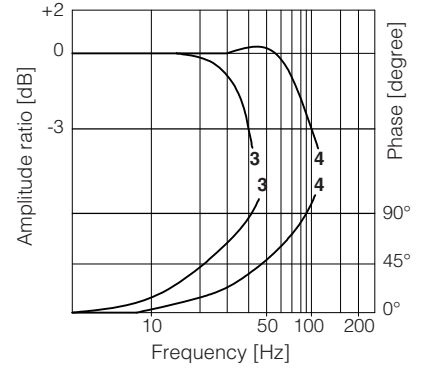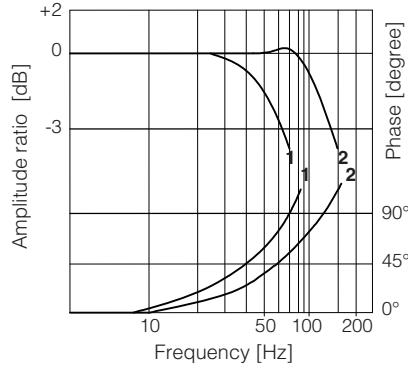
20.3 Bode diagrams
Stated at nominal hydraulic conditions

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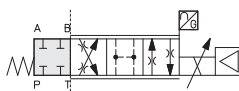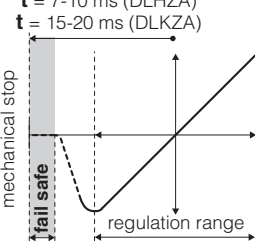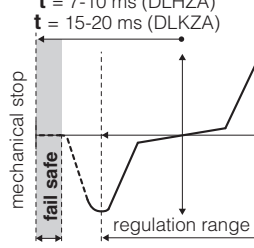**2** = ±   5% nominal stroke
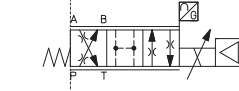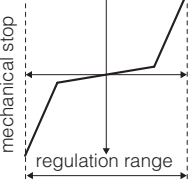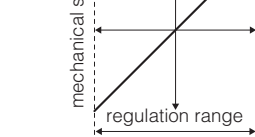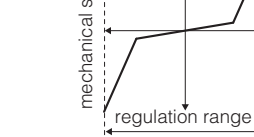
DLKZA:
3 = ± 100% nominal stroke
4 = ±   5% nominal stroke

| 21 | **FAIL SAFE POSITION** |

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

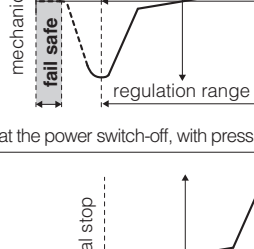| Fail safe connections		**P → A**	**P → B**	**A → T**	**B → T**
Leakage [cm³/min] at P = 100 bar **(1)**	Fail safe 1	50	70	70	50
	Fail safe 3	50	70	-	-
Flow [l/min] **(2)** DLHZA	Fail safe 3	-	-	15÷30	10÷20
DLKZA		-	-	40÷60	25÷40

(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

FX610

22 POWER SUPPLY AND SIGNALS SPECIFICATIONS

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

22.1 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.

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

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

The separate power supply for axis card logic on pin 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 axis card logic and communication power supply: 500 mA fast fuse.

22.3 Position reference input signal (P_INPUT+)

Functionality of P_INPUT+ signal (pin 10), depends on axis card reference mode, see section 2 :

external analog reference (see 2.1): input is used as reference for control in closed loop the actuator position.

Reference input signal is factory preset according to selected valve code, defaults are ±10 VDC for standard and 4 ÷ 20 mA for /I option.

Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.

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

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

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

SF, SL controls and external analog reference selected : input is used as reference for the axis card force closed loop.

Reference input signal is factory preset according to selected valve code, defaults are ±10 VDC for standard and 4 ÷ 20 mA for /I option.

Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.

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

22.5 Position monitor output signal (P_MONITOR)

The axis card 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 axis card (e.g. analog reference, fieldbus reference, position error, valve spool position).

Monitor output signal is factory preset according to selected valve code, defaults are ±10 VDC for standard and 4 ÷ 20 mA for /I option.

Output signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.

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

The axis card generates an analog output signal (pin 11) according to alternated 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 force applied to the cylinder's rod end

Monitor output signals can be software set to show other signals available in the axis card (e.g. analog reference, force reference).

The output range and polarity are software selectable within the maximum range ±10 VDC or ±20 mA.

Monitor output signal is factory preset according to selected valve code, defaults are ±10 VDC for standard and 4 ÷ 20 mA for /I option.

Output signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.

22.7 Enable input signal (ENABLE)

To enable the axis card, a 24VDC voltage has to be applied on pin 6.

When the Enable signal is set to zero the axis card can be software set to perform one of the following actions:

- maintain the actuator actual position in close loop control
- move towards a predefined position in closed loop control and maintains the reached position (hold position)
- move forward or backward in open loop (only the valve's closed loop remain active)

22.8 Fault output signal (FAULT)

Fault output signal indicates fault conditions of the axis card (solenoid short circuits/not connected, reference or transducer signal cable broken, maximum error exceeded, etc.). Fault presence corresponds to 0 VDC, normal working corresponds to 24 VDC.

Fault status is not affected by the Enable input signal.

Fault output signal can be used as digital output by software selection.

22.9 Position transducer input signal

A position transducer must be always directly connected to the axis card. Select the correct axis card execution depending on the desired transducer interface: digital SSI or Encoder (D execution), potentiometer or a generic transducer with analog interface (A execution).

Position digital input signal is factory preset to binary SSI, it can be reconfigured via software selecting between binary/gray SSI and Encoder.

Position analog input signal is factory preset according to selected valve code, defaults are ±10 VDC for standard and 4 ÷ 20 mA for /C option.

Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.

Refer to position transducer characteristics to select the transducer type according to specific application requirements (see 23.1).

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

Analog remote pressure transducers or load cell can be directly connected to the axis card.

Analog input signal is factory preset according to selected valve code, defaults are ±10 VDC for standard and 4 ÷ 20 mA for /C option.

Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of ±10 VDC or ± 20 mA.

Refer to pressure/force transducer characteristics to select the transducer type according to specific application requirements (see 23.2).

23 ACTUATOR'S TRANSDUCER CHARACTERISTICS

23.1 Position transducers

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

### 23.2 Pressure/force transducers

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

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

Execution	Position				Pressure/Force
	A		**D**		**SF, SL**
Input type	Potentiometer	Analog	SSI **(3)**	Incremental Encoder	Analog
Power supply **(1)**	10 ÷ 30 V_{DC}	+24 V_{DC}	+24 V_{DC}	+5 V_{DC} / +24 V_{DC}	+24 V_{DC}
Axis card interface	0 ÷ 10 V	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	1 m/s	2 m/s	-
Max resolution	< 0.4 % FS	< 0.2 % FS	5 μm	1 μm (@ 0.15 m/s)	< 0.4 % FS
Linearity error **(2)**	± 0.1% FS	< ±0.02% FS	< ± 0.02 % FS	< ± 0.001 % FS	< ±0.25% FS
Repeatability **(2)**	± 0.05% FS	< ± 0.005% FS	< ± 0.005 % FS	< ± 0.001 % FS	< ±0.1% FS

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

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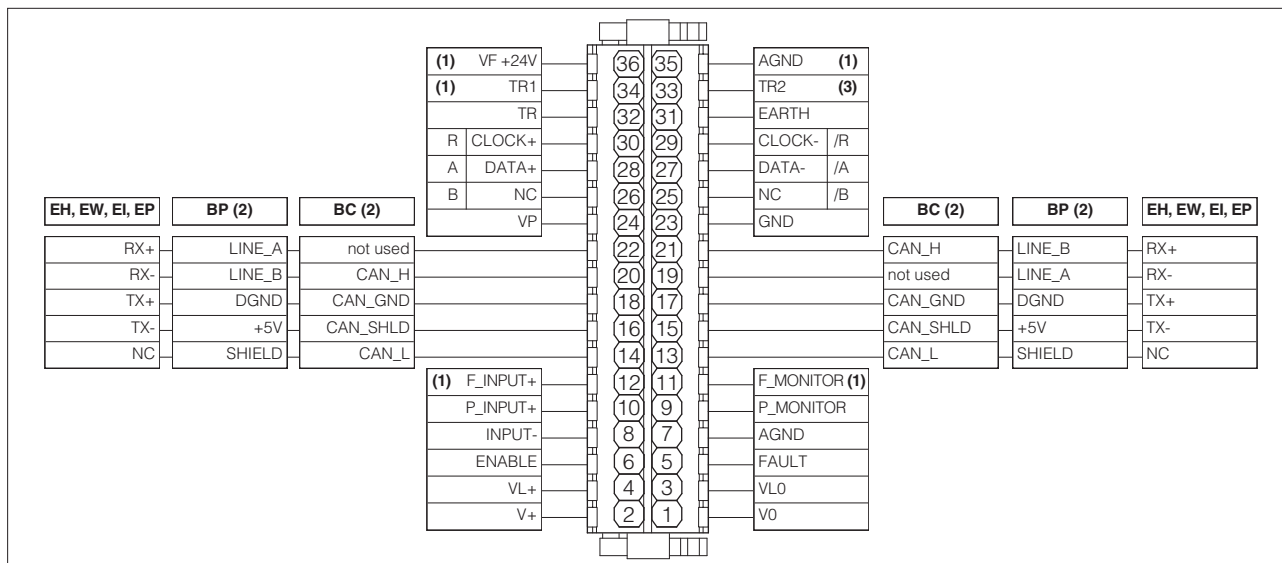
(1) Connections available only for **SF**, **SL**
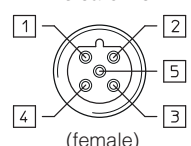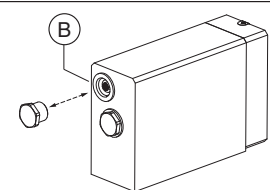**(2)** For BC and BP executions the fieldbus connections have an internal pass-through connection
(3) Connection available only for **SF**

25 ELECTRONIC CONNECTIONS

25.1 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 axis card logic and communication	Gnd - power supply
	4	**VL+**	Power supply 24 V_{DC} for axis card 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 axis card, 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**	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+**	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 axis card housing	

25.2 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 +

Axis card view

```
[1]       [2]
     1
[ ]     [ ]   5
   4
[4]       [3]
```
(female)

25.3 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

25.4 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)

25.5 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

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

CABLE ENTRANCES	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES	SL - Single transducer Voltage	Current	SF - Double transducers 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

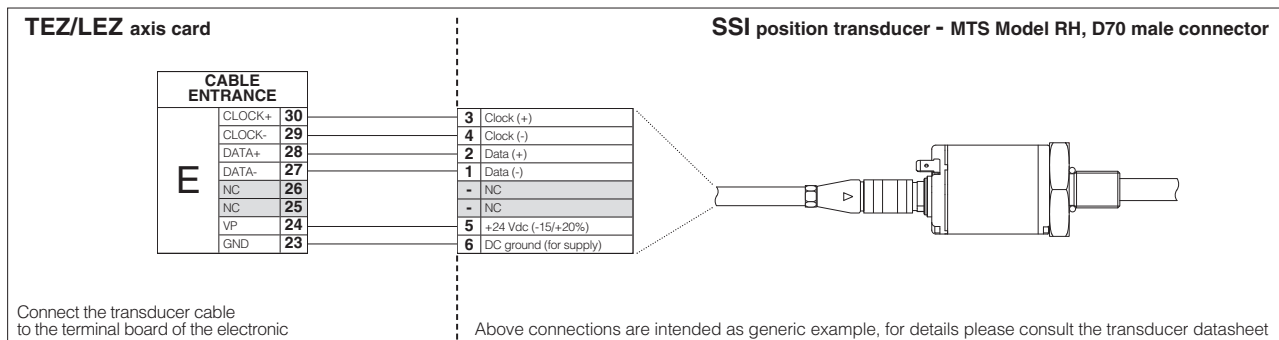**E-ATRA remote pressure transducer connection** - see tech table **GX800**

for **SF** option

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

CABLE ENTRANCE D2		Current signal	E-ATRA pressure transducer
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
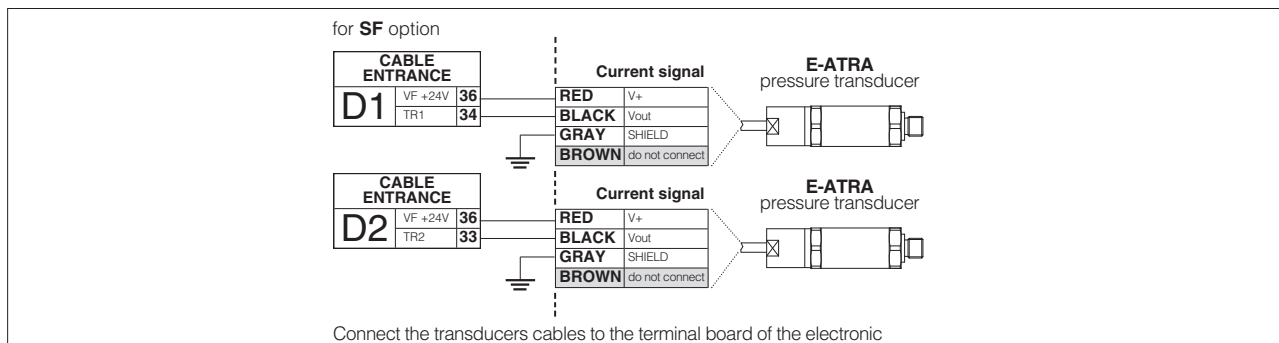
25.7 D execution - Digital position transducers connections

| 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 22.9

SSI connection - example

TEZ/LEZ axis card

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 datasheet

Encoder connection - example

TEZ/LEZ axis card

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 datasheet
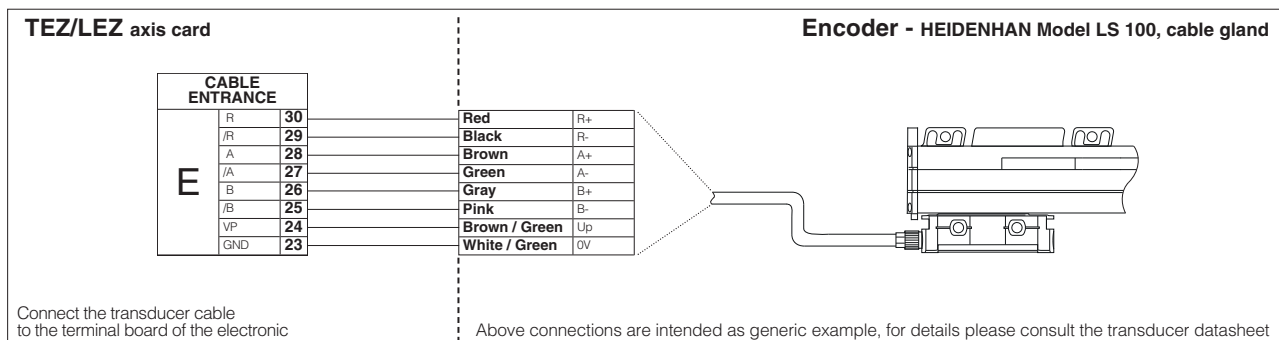
25.8 A execution - Analog position transducers connector

| 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:

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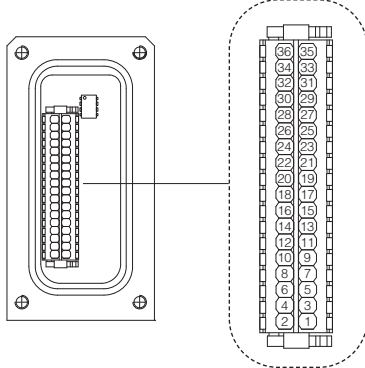- (E) position transducer
- (P) threaded plug

all versions (front)

NP (rear)

BC, BP EH, EI, EW, EP (rear)
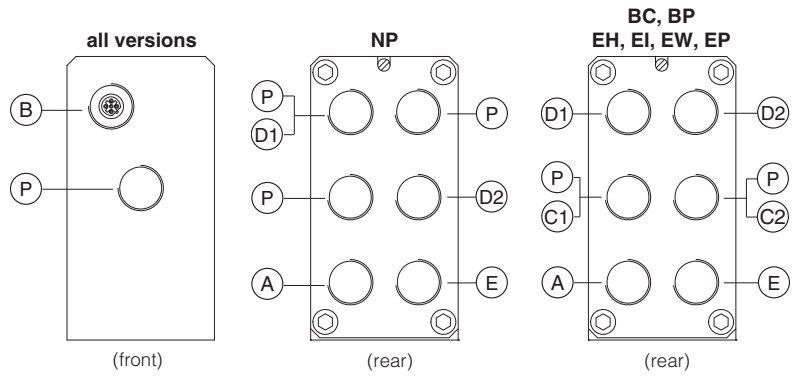
TERMINAL BOARD AND FIELDBUS TERMINATOR

Remove the 4 screws of axis card rear cover to access terminal board and fieldbus terminator

FRONT

5

n°4 M6
Tightening torque **15 Nm**

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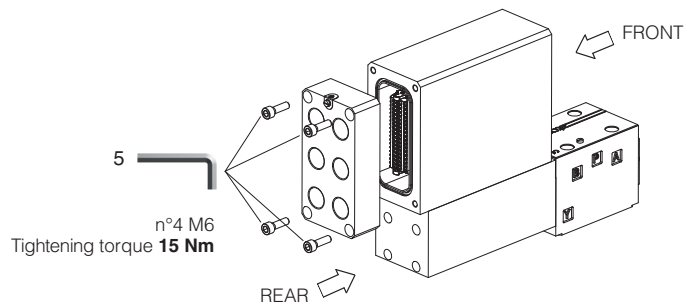
⚠ **WARNING:** the above operation must be performed in a safety area

Terminal board - see section 24

Fieldbus terminator only for BC and BP executions **(1)**
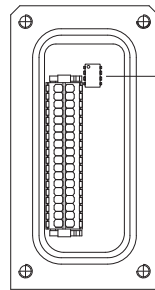
BC - CANopen setting:

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

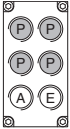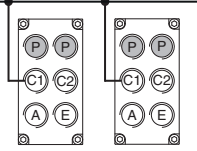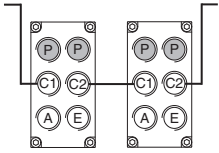**E-C-SB-USB/M12**
USB CABLE
cable lenght 4m

Ø15
~ 50

male **(2)**

DO NOT REMOVE
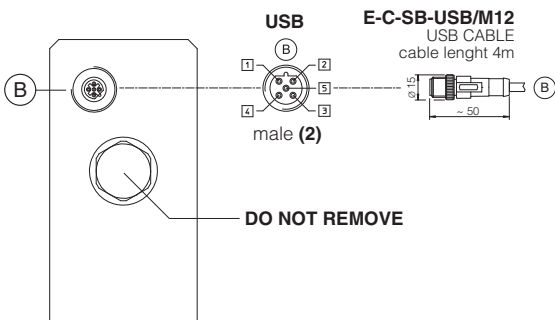
METALLIC PROTECTION CAP - supplied with the valves

24

M20x1.5

~ 20

Tightening torque: **20 Nm**
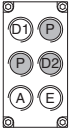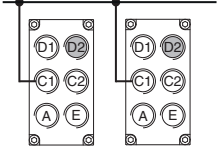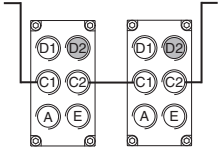
DO NOT REMOVE

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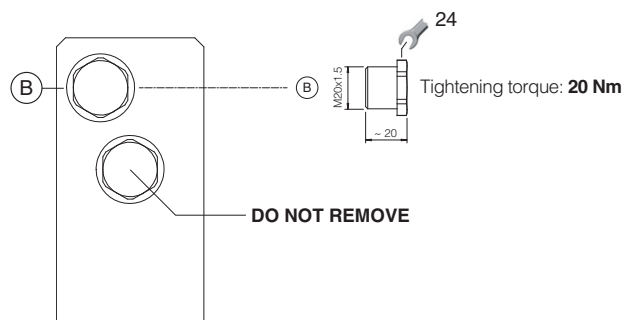
(1) On-board digital driver + axis card with BC and BP fieldbus interface are delivered by default 'Not Terminated'. All switches are set OFF
(2) Pin layout always referred to on-board digital driver + axis card view

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

Communication interfaces	To be ordered separately				Cable entrance overview	Notes
	Cable gland		Threaded plug			
	quantity	entrance	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

26.2 Cable glands and threaded plug for TEZ-SF, SL - see tech table **KX800**

Communication interfaces	To be ordered separately				Cable entrance overview	Notes
	Cable gland		Threaded plug			
	quantity	entrance	quantity	entrance		
NP	4 (SF) 3 (SL)	D1 D2 A - E	none	none		Cable entrance A , E , D1 are open for costumers Cable entrance P , D2 are factory plugged **(1)**
BC, BP, EH, EW, EI, EP "via stub" connection	5 (SF) 4 (SL)	D1 - D2 C1 A - E	1	C2		Cable entrance A , E , C1 , C2 , D1 are open for costumers Cable entrance D2 is factory plugged **(1)**
BC, BP, EH, EW, EI, EP "daisy chain" connection	6 (SF) 5 (SL)	D1 - D2 C1 - C2 A - E	none	none		Cable entrance A, E, C1, C2, D1, D2 are open for costumers Cable entrance D2 is factory plugged **(1)**

(1) Remove plug D2 for second transducer connection of SF version

FX610

27 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**

27.1 External reference and transducer parameters

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

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

27.2 PID control dynamics parameters

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

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

27.3 Monitoring parameters

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

- *Monitoring parameters*   maximum allowed errors can be set for both static and dynamic positioning phases, and dedicated waiting times can be set to delay the activation of the alarm condition and relevant reaction (see 27.4)

27.4 Fault parameters

Allow to configure how the axis card 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, axis card disabling, etc.)

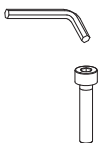### 27.5 Valve characteristics compensation

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

27.6 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).

28 FASTENING BOLTS AND SEALS

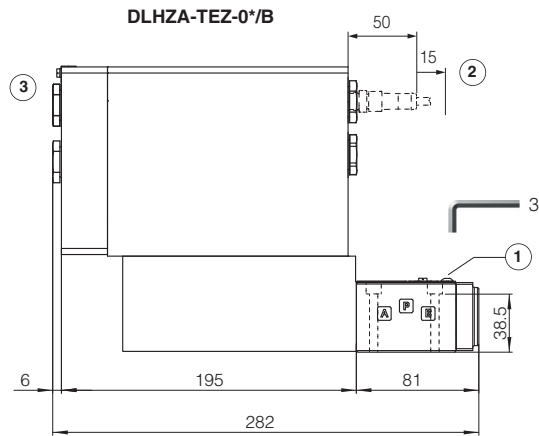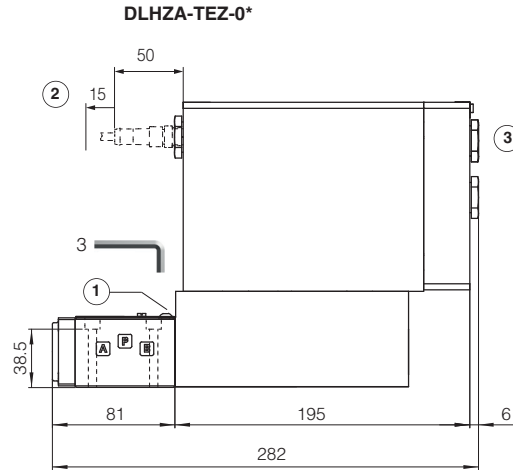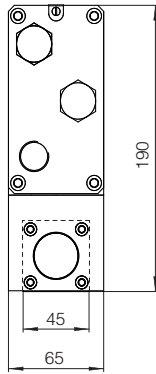|	DLHZA	DLKZA
	Fastening bolts: 4 socket head screws M5x50 class 12.9 Tightening torque = 8 Nm	**Fastening bolts:** 4 socket head screws M6x40 class 12.9 Tightening torque = 15 Nm
	Seals: 4 OR 108; Diameter of ports A, B, P, T: Ø 7,5 mm (max) 1 OR 2025 Diameter of port Y: Ø = 3,2 mm (only for /Y option)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

50
15
②
③
190
45
65
①
38.5
A P B
3
81
195
6
282

DLHZA-TEZ-0*/B

50
15
②
③
3
①
38.5
A P B
6
195
81
282

① = Air bleeding

② = Space to remove the USB connector

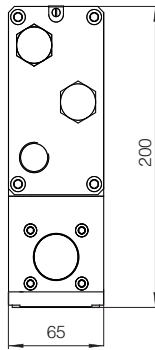③ = The dimensions of cable glands must be considered (see tech table **KX800**)

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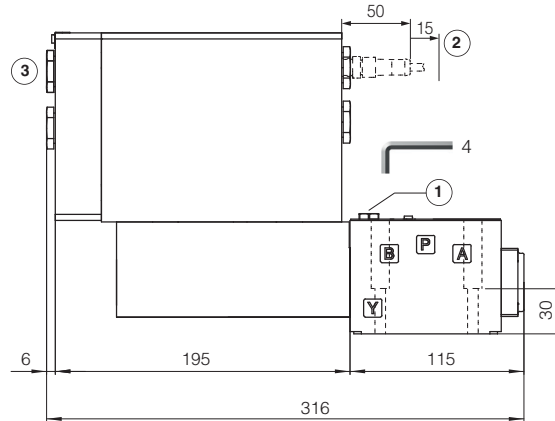
DLKZA-TEZ

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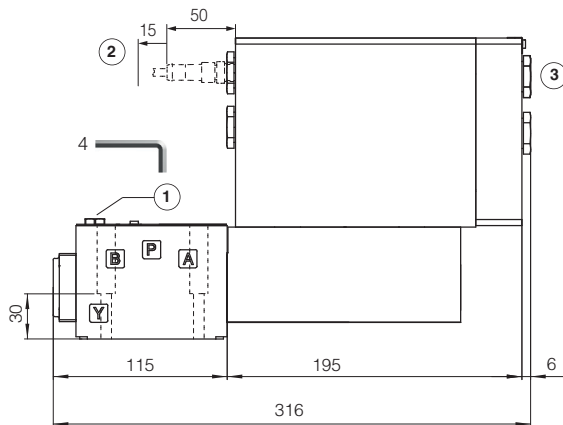**(for /Y surface 4401-05-05-0-05 without X port)**

Mass [kg]	
DLKZA-TEZ	9

DLKZA-TEZ-1*

DLKZA-TEZ-1*/B

① = Air bleeding

② = Space to remove the USB connector

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

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

30 RELATED DOCUMENTATION

X010	Basics for electrohydraulics in hazardous environments	**GX800**	Ex-proof pressure transducer type E-ATRA-7
X020	Summary of Atos ex-proof components certified to ATEX, IECEx, EAC, CCC, PESO	**KX800**	Cable glands for ex-proof valves
FX500	Ex-proof digital proportionals with P/Q control	**P005**	Mounting surfaces for electrohydraulic valves
FX900	Operating and manintenance information for ex-proof proportional valves	**Z-MAN-RA-LEZ**	TEZ/LEZ user manual
GS500	Programming tools	**Z-MAN-RA-LEZ-S**	TEZ/LEZ with P/Q control user manual
GS510	Fieldbus		