



Table **GS330-1/E**

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

DIN-rail format, for position and force controls

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

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

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

Position Control	Alternated Control <b>P/Q</b>	Internal Reference	<p><b>Z-SW-FULL</b> programming software</p>
Real-time Fieldbus Reference	Enhanced Diagnostic	USB port	

Connectors ② included

## Z-BM-TEZ/LEZ

Digital axis cards ① perform the driver functions for proportional valves plus the position closed loop control of the linear or rotative actuator to which the proportional valve is connected.

Z-BM-TEZ execution controls direct and pilot operated directional valves with one LVDT transducer.

Z-BM-LEZ execution controls directional pilot operated valves with two LVDT transducers. The controlled actuator has to be equipped with integral or external position transducer (analog, SSI or Encoder) to feedback the axis position.

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

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

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

### Electrical Features:

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

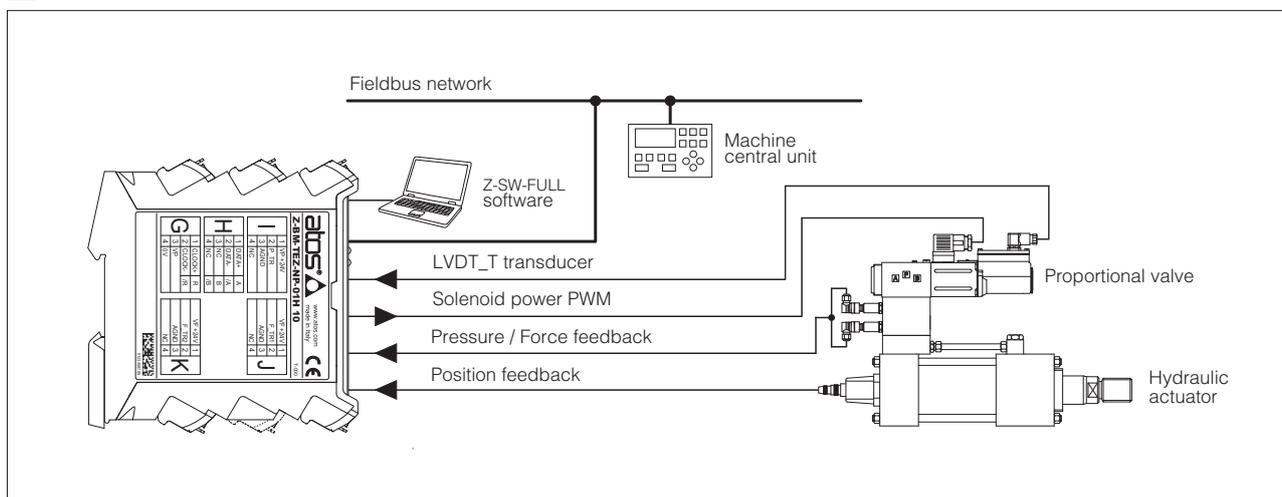
### Software Features:

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

## 1 MODEL CODE

<b>Z-BM</b>	-	<b>TEZ</b>	-	<b>NP</b>	-	<b>01H</b> / *	/	*	/	*
Off-board electronic axis card in DIN rail format										
<b>TEZ</b> = digital full driver + axis card, for valves with one LVDT transducer <b>LEZ</b> = digital full driver + axis card, for valves with two LVDT transducers										
<b>Fieldbus interface</b> , USB port always present: <b>NP</b> = Not Present <b>BC</b> = CANopen <b>EW</b> = POWERLINK <b>BP</b> = PROFIBUS DP <b>EI</b> = EtherNet/IP <b>EH</b> = EtherCAT <b>EP</b> = PROFINET RT/IRT										
Set code (see section 9)										
Series number										
<b>Options</b> , see section 3 : <b>A</b> = max current limitation for Ex-proof valves <b>C</b> = current feedback 4 ÷ 20 mA for LVDT transducers, only in combination with option A										
<b>01H</b> = for single solenoid proportional valves <b>05H</b> = for double solenoid proportional valves (only for <b>TEZ</b> )										

2 BLOCK DIAGRAM EXAMPLE



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

3 VALVES RANGE

Valves	Directional		
Standard Data sheet	<b>DHZO-T, DKZOR-T</b> F165	<b>DLHZO-T, DLKZOR-T</b> F180	<b>DPZO-L</b> F175
Ex-proof Data sheet	-	<b>DLHZA-T, DLKZA-T</b> FX140	-
Controller model	<b>Z-BM-TEZ</b>		<b>Z-BM-LEZ</b>

4 POSITION REFERENCE MODE

4.1 External reference generation

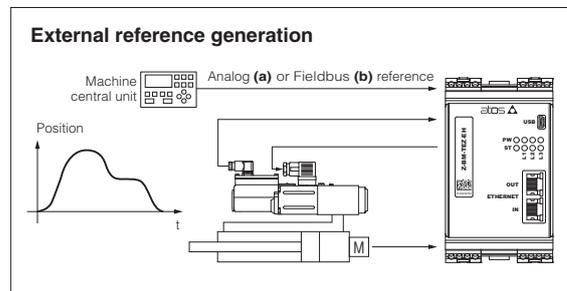
Axis controller regulates in closed loop the actuator position according to an external reference position signal and to the position feedback from the actuator transducer.

The external reference signal can be software selected among:

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

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

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



4.2 Internal reference generation

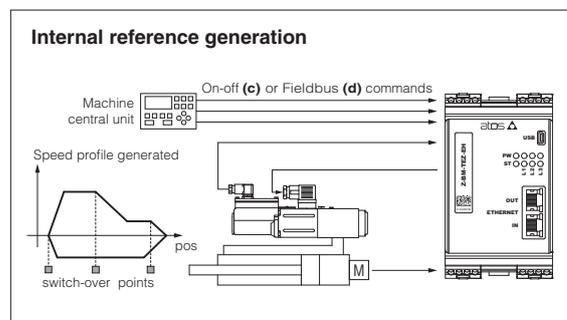
Axis controller regulates in closed loop the actuator position according to an internally generated reference position signal and to the position feedback from the actuator transducer. The internal reference signal is generated by a pre-programmed cycle; only start, stop and switch-over commands are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

- on-off commands (c)

- fieldbus commands (d)

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

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



Start / stop / switch-over commands examples

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

Reference generation types examples

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

**5 ALTERNATED POSITION / FORCE CONTROL**

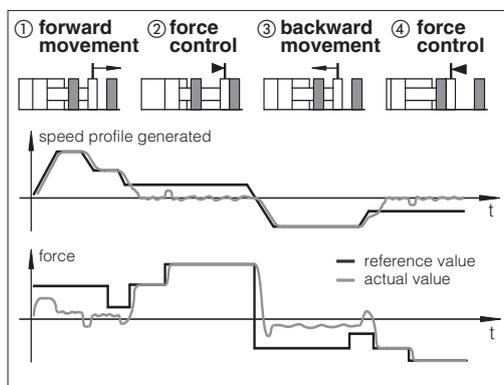
Alternated pressure or force closed loop control can be added to the actuator's standard position control, requiring one or two remote transducers (pressure or force) that have to be installed on the actuator, see below functional schemes.

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

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

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

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



**Alternated control configurations - software selectable**

SP	SF	SL	
one remote pressure transducer has to be installed on the actuator's port to be controlled	two remote pressure transducers have to be installed on the actuator's ports; the actuator force is calculated by the pressure feedbacks (Pa - Pb)	one load cell transducer has to be installed between the actuator and the controlled load	
<b>T</b> valve's spool transducer	<b>M</b> actuator's position transducer	<b>P</b> pressure transducer	<b>L</b> load cell

**SP – position/pressure control**

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

**SF – position/force control**

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

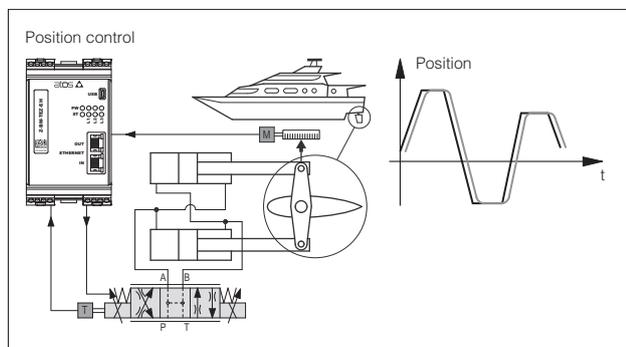
**SL – position/force control**

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

**General Notes:**

- servoproportional type DLHZO, DLKZOR and DPZO-L are strongly recommended for high accuracy applications see tech tables **F180, F175**
- auxiliary check valves are recommended in case of specific hydraulic configuration requirements in absence of power supply or fault, see tech table **EY105**
- for additional information about alternated P/Q controls configuration please refer to tech table **GS002**
- Atos technical service is available for additional evaluations related to specific applications usage

**6 APPLICATION EXAMPLES**

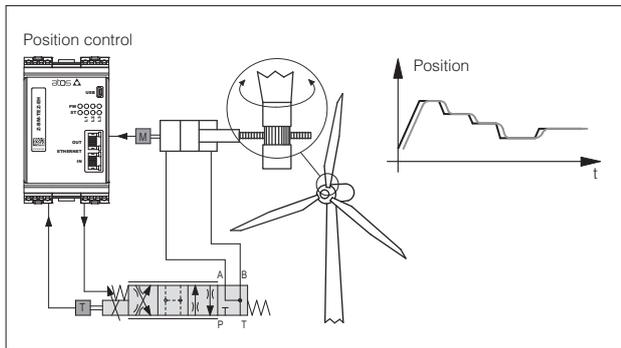


**Hydraulic steering wheel in marine applications**

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

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

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

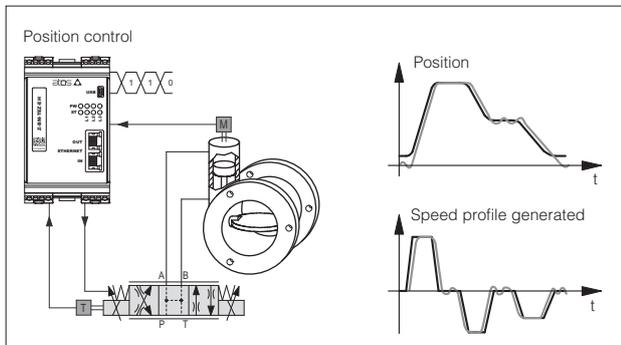


**Wind turbines**

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

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

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

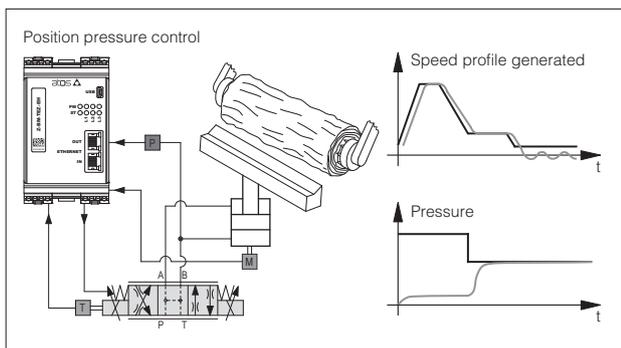


**Process valves**

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

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

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

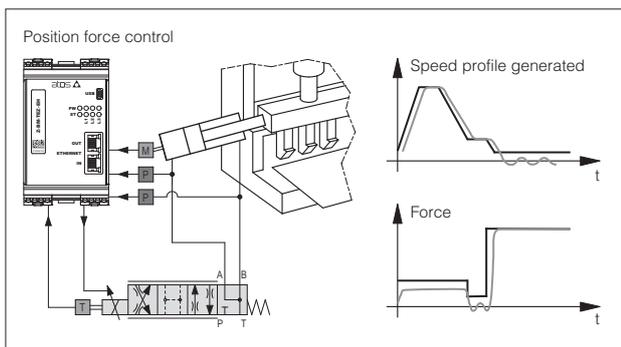


**Wood machinery**

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

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

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

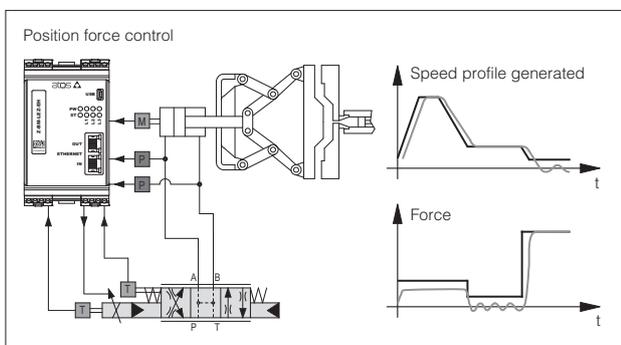


**Bending Machines**

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

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

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



**Die-casting machinery**

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

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

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



## 8.2 Connectors - 4 pin

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

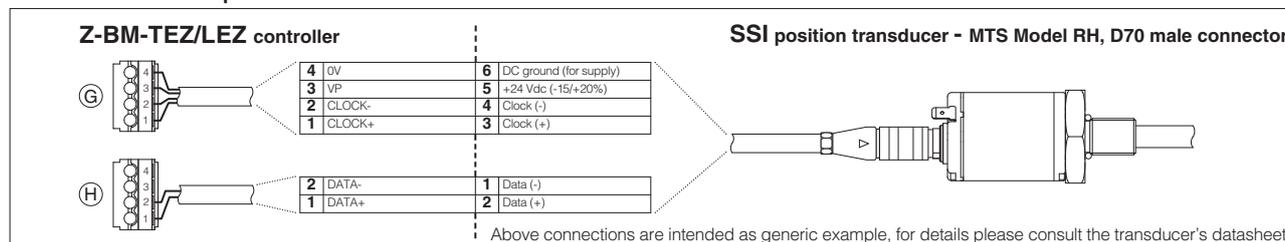
(1) D connector is available only for Z-BM-LEZ-\*\*-01H

8.3 SSI connectors signals - 4 pin

G	G1	<b>CLOCK+</b>	Serial synchronous clock (+)	Output - on/off signal
	G2	<b>CLOCK-</b>	Serial synchronous clock (-)	Output - on/off signal
	G3	<b>VP</b>	Power supply: +24Vdc, +5Vdc or OFF (default OFF)	Output - power supply <b>Software selectable</b>
	G4	<b>0V</b>	Common gnd for transducer power and signals	Common gnd
H	H1	<b>DATA+</b>	Serial position data (+)	Input - on/off signal
	H2	<b>DATA-</b>	Serial position data (-)	Input - on/off signal
	H3	<b>NC</b>	Do not connect	
	H4	<b>NC</b>	Do not connect	

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

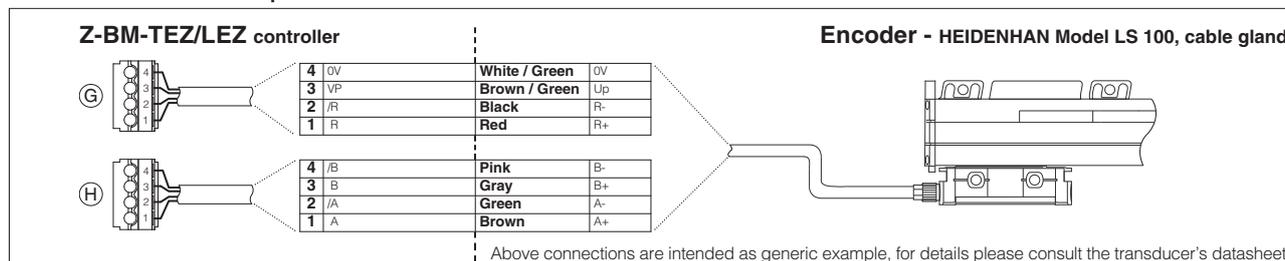
SSI connection - example



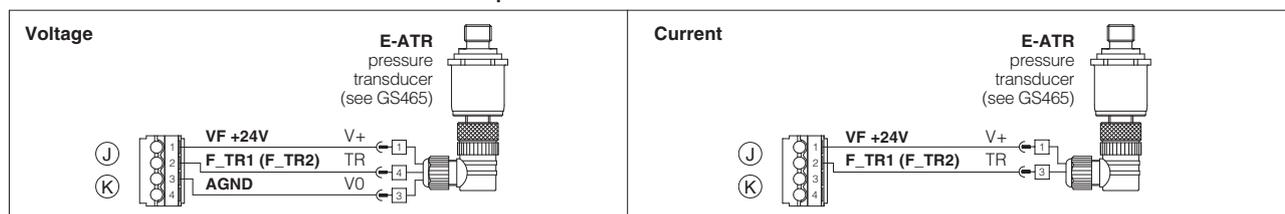
8.4 Encoder connectors signals - 4 pin

G	G1	<b>R</b>	Input channel R	Input - on/off signal
	G2	<b>/R</b>	Input channel /R	Input - on/off signal
	G3	<b>VP</b>	Power supply: +24Vdc, +5Vdc or OFF (default OFF)	Output - power supply <b>Software selectable</b>
	G4	<b>0V</b>	Common gnd for transducer power and signals	Common gnd
H	H1	<b>A</b>	Input channel A	Input - on/off signal
	H2	<b>/A</b>	Input channel /A	Input - on/off signal
	H3	<b>B</b>	Input channel B	Input - on/off signal
	H4	<b>/B</b>	Input channel /B	Input - on/off signal

Encoder connection - example



8.5 Pressure/force transducers connection - example



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

③ **USB connector - Mini USB type B** always present

PIN	SIGNAL	TECHNICAL SPECIFICATION (1)
1	<b>+5V_USB</b>	Power supply
2	<b>D-</b>	Data line -
3	<b>D+</b>	Data line +
4	<b>ID</b>	Identification
5	<b>GND_USB</b>	Signal zero data line

⑤ **BP fieldbus execution, connector - DB9 - 9 pin**

PIN	SIGNAL	TECHNICAL SPECIFICATION (1)
1	<b>SHIELD</b>	
3	<b>LINE-B</b>	Bus line (low)
5	<b>DGND</b>	Data line and termination signal zero
6	<b>+5V</b>	Termination supply signal
8	<b>LINE-A</b>	Bus line (high)

④ **BC fieldbus execution, connector - DB9 - 9 pin**

PIN	SIGNAL	TECHNICAL SPECIFICATION (1)
2	<b>CAN_L</b>	Bus line (low)
3	<b>CAN_GND</b>	Signal zero data line
5	<b>CAN_SHLD</b>	Shield
7	<b>CAN_H</b>	Bus line (high)

⑥ ⑦ **EH, EW, EI, EP fieldbus execution, connector - RJ45 - 8 pin**

PIN	SIGNAL	TECHNICAL SPECIFICATION (1)
1	<b>TX+</b>	Transmitter - white/orange
2	<b>TX-</b>	Transmitter - orange
3	<b>RX+</b>	Receiver - white/green
6	<b>RX-</b>	Receiver - green

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

**9 SET CODE**

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

**10 SIGNALS SPECIFICATIONS**

Atos digital drivers are CE marked according to the applicable directives (e.g. Immunity and Emission EMC Directive).

Installation, wirings and start-up procedures must be performed according to the general prescriptions shown in tech table **F003** and in the user manuals included in the Z-SW programming software.

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

**10.1 Power supply (V+ and V0)**

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



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

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

The power supply (pin A3 and A4) for driver's logic and communication must be appropriately stabilized or rectified and filtered: apply at least a 10000  $\mu$ F/40 V capacitance to single phase rectifiers or a 4700  $\mu$ F/40 V capacitance to three phase rectifiers.

The separate power supply for driver's logic, allow to remove solenoid power supply from pin A1 and A2 maintaining active the diagnostics, USB and fieldbus communications.



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

**10.3 Position reference input signal (P\_INPUT+)**

Functionality of P\_INPUT+ signal (pin B1), depends on controllers' reference mode, see section [4](#):

*external analog reference generation* (see 4.1): input is used as reference for the controller position closed loop.

Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of  $\pm 10$  Vdc or  $\pm 20$  mA; default is  $\pm 10$  Vdc

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

**10.4 Pressure or force reference input signal (F\_INPUT+)**

Functionality of F\_INPUT+ signal (pin B3), depends on selected controllers' reference mode and alternated control options, see section [5](#):

*SP, SL, SF controls and external analog reference selected*: input is used as reference for the controller pressure/force closed loop.

Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of  $\pm 10$  Vdc or  $\pm 20$  mA; default is  $\pm 10$  Vdc

*SN control or fieldbus/internal reference selected*: analog reference input signal can be used as on-off commands with input range  $0 \div 24$ Vdc

**10.5 Position monitor output signal (P\_MONITOR)**

The controller generates an analog output signal (pin C1) proportional to the actual axis position; the monitor output signal can be software set to show other signals available in the controller (e.g. analog reference, fieldbus reference, position error, valve spool position).

The output range and polarity are software selectable within the maximum range  $\pm 10$  Vdc or  $\pm 20$  mA; default is  $\pm 10$  Vdc

**10.6 Pressure or force monitor output signal (F\_MONITOR)**

The controller generates an analog output signal (pin C3) according to alternated pressure/force control option:

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

*SP, SL, SF controls*: output signal is proportional to the actual pressure/force 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  $\pm 10$  Vdc or  $\pm 20$  mA; default is  $\pm 10$  Vdc

**10.7 Enable Input Signal (ENABLE)**

To enable the controller, a 24Vdc voltage has to be applied on pin C2

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

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

**10.8 Fault output signal (FAULT)**

Fault output signal (pin C4) indicates fault conditions of the controller (solenoid short circuits/not connected, reference or transducer signal cable broken, maximum error exceeded, etc.). Fault presence corresponds to 0 Vdc, normal working corresponds to 24 Vdc

Fault status is not affected by the status of the Enable input signal.

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

**10.9 Position transducer input signals**

A position transducer must be always directly connected to the controller. Position digital input signals are factory preset to binary SSI, they can be reconfigured via software selecting between binary/gray SSI, Encoder or generic transducer with analog interface.

Input signals can be reconfigured via software selecting between voltage and current, within a maximum range of  $\pm 10$  Vdc or  $\pm 20$  mA; default is  $\pm 10$  Vdc

Refer to position transducer characteristics to select the transducer type according to specific application requirements, see section [11](#).

**10.10 Remote pressure/force transducer input signals (F\_TR1 and F\_TR2) - SP, SF, SL controls**

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

Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of  $\pm 10$  Vdc or  $\pm 20$  mA; default is  $\pm 10$  Vdc

Refer to pressure/force transducer characteristics to select the transducer type according to specific application requirements, see section [11](#).

**10.11 Main stage and direct or pilot position transducer input signals (LVDT\_L and LVDT\_T)**

Main stage (LVDT\_L pin D1) and direct or pilot (LVDT\_T pin E1) position transducer integrated to the valve have to be directly connected to the controller using  $\pm 15$  Vdc supply output available at pin D2, D3 and pin E2, E3.

Note: transducer input signals working range is  $\pm 10$  Vdc for standard or  $4 \div 20$  mA for /C option and **cannot** be reconfigured via software (input signals setting depends to the driver set code).

**10.12 Possible combined options: /AC**

**11 ACTUATOR'S TRANSDUCER CHARACTERISTICS****11.1 Position transducers**

The accuracy of the position control is strongly dependent to the selected position transducer. Four different transducer interfaces are available on the controllers, depending to the system requirements: analog signal (analog), SSI or Encoder (digital).

Transducers with digital interface allow high resolution and accurate measures, that combined with fieldbus communication grants highest performances. Transducers with analog interface grant simple and cost effective solutions.

**11.2 Pressure/force transducers**

The accuracy of the pressure/force control is strongly dependent to the selected pressure/force transducer (see section 5). Alternated pressure/force controls require to install pressure transducers or load cell to measure the actual pressure/force values.

Pressure transducers allow easy system integration and cost effective solution for both alternated position/pressure and position/force controls (see tech table **GS465** for pressure transducers details). Load cell transducers allow the user to get high accuracy and precise regulations for alternated position/force control.

The characteristics of the remote pressure/force transducers must be always selected to match the application requirements and to obtain the best performances: transducer nominal range should be at least 115%÷120% of the maximum regulated pressure/force.

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

	Position			Pressure/Force
	Analog	SSI (3)	Incremental Encoder	Analog
Power supply (1)	+24 Vdc	+5 Vdc or +24 Vdc	+5 Vdc or +24 Vdc	+24 Vdc
Controller Interface	0 ÷ 10V or 4 ÷ 20 mA	Serial SSI binary/gray	TTL 5Vpp - 150 KHz	±10 Vdc or 4 ÷ 20 mA
Max speed	1 m/s	2 m/s	2 m/s	-
Max Resolution	< 0.2 % FS	1 µm	1 µm (@ 0.15 m/s)	< 0.4 % FS
Linearity error (2)	< ±0.03% FS	< ± 0.01 % FS	< ± 0.001 % FS	< ±0.25% FS
Repeatability (2)	< ± 0.005% FS	< ± 0.001 % FS	< ± 0.001 % FS	< ±0.1% FS

(1) power supply provided by Atos controller (2) percentage of total stroke (3) for Balluff BTL7 with SSI interface only special code SA433 is supported

**12 VALVE SETTINGS AND PROGRAMMING TOOLS**

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

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

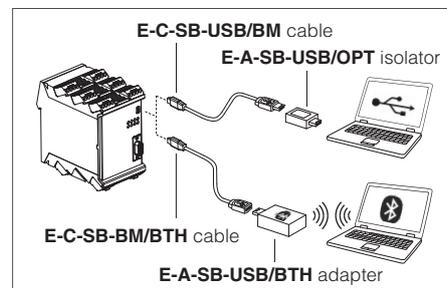
<b>Z-SW-FULL</b>	support:	NP (USB)	PS (Serial)	IR (Infrared)
		BC (CANopen)	BP (PROFIBUS DP)	EH (EtherCAT)
		EW (POWERLINK)	EI (EtherNet/IP)	EP (PROFINET)



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



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

**USB or Bluetooth connection**

DVD programming software, to be ordered separately:

**Z-SW-FULL** DVD first supply = software has to be activated via web registration at [www.atos.com](http://www.atos.com) ; 1 year service included  
Upon web registration user receive via email the Activation Code (software license) and login data to access Atos Download Area

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

**Atos Download Area:** direct access to latest releases of Z-SW software, manuals, USB drivers and fieldbus configuration files at [www.atos.com](http://www.atos.com)

**USB Adapters, Cables and Terminators, can be ordered separately**

**13 MAIN SOFTWARE PARAMETER SETTINGS**

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

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

**13.1 External reference and transducer parameters**

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

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

**13.2 PID control dynamics parameters**

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

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

**13.3 Monitoring parameters**

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

- *Monitoring parameters* maximum allowed errors can be set for both static and dynamic positioning phases, and dedicated waiting times can be set to delay the activation of the alarm condition and relevant reaction (see 13.4)

**13.4 Fault parameters**

Allow to configure how the controller detect and react to alarm conditions:

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

**13.5 Valve characteristics compensation**

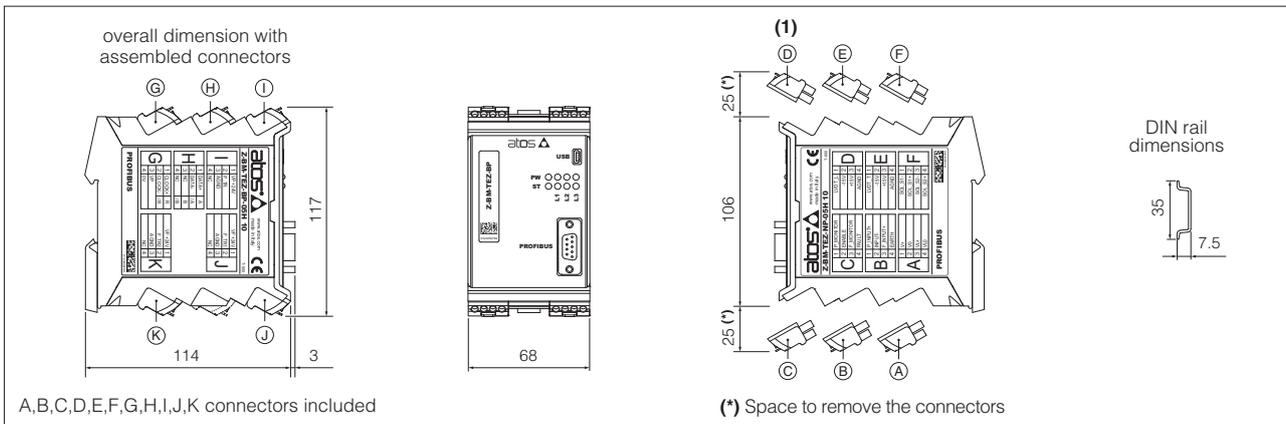
Allow to modify the valve regulation to match the actuator/system characteristics and to obtain the best overall performances:

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

**13.6 Motion phases parameters**

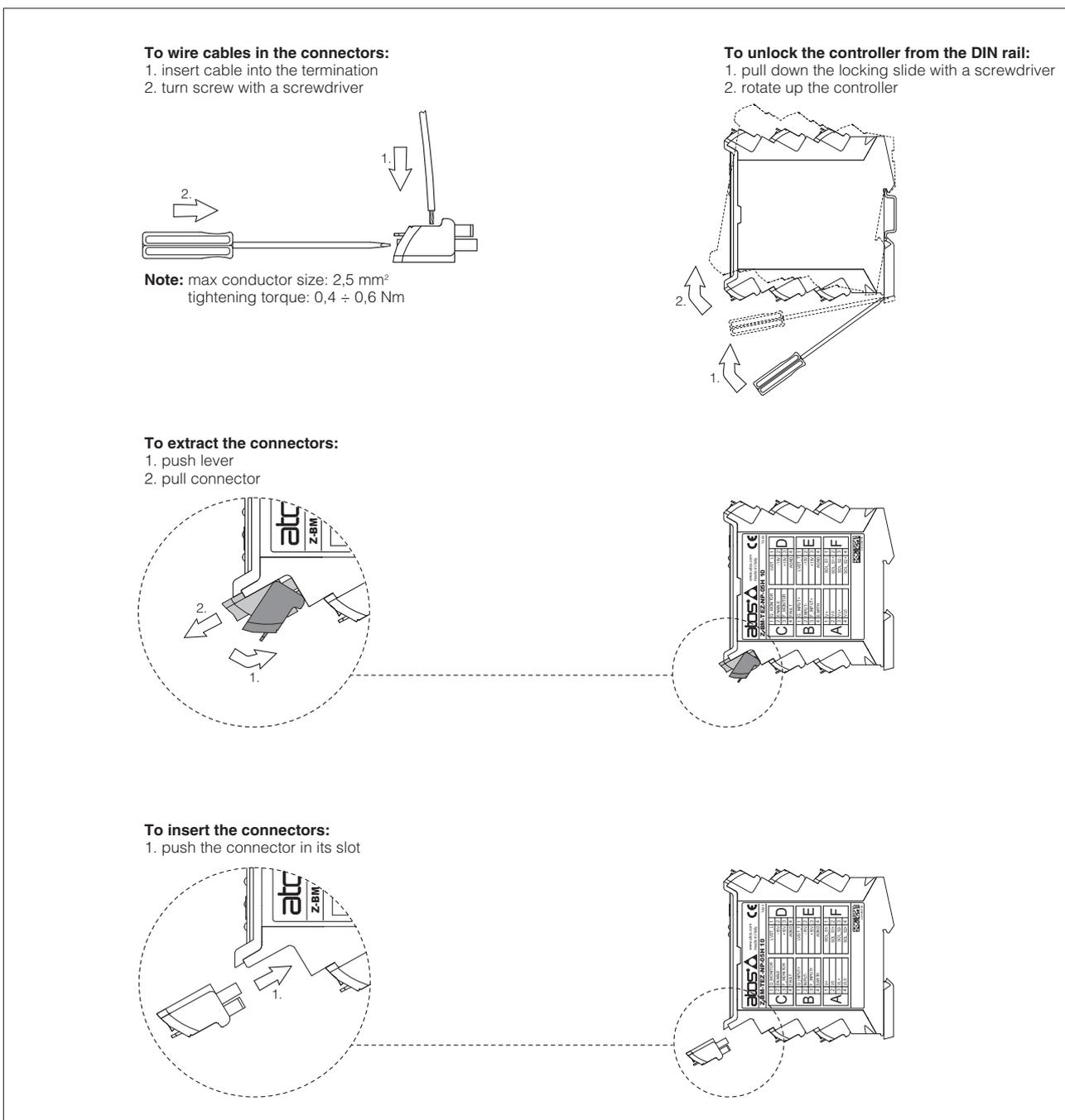
When the internal reference generation is active a pre-programmed cycle can be generated; start/stop/switch-over commands and reference generation types parameters can be set to design a customized sequence of motion phases adapted to the specific application requirements (see 4.2).

14 OVERALL DIMENSIONS [mm]



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

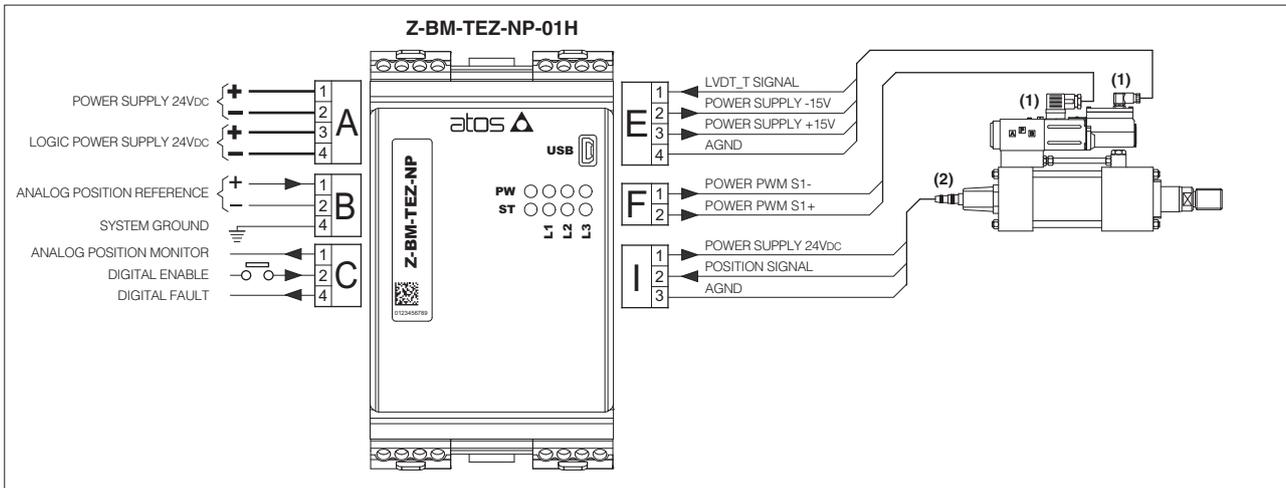
15 INSTALLATION



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

16 WIRING EXAMPLES

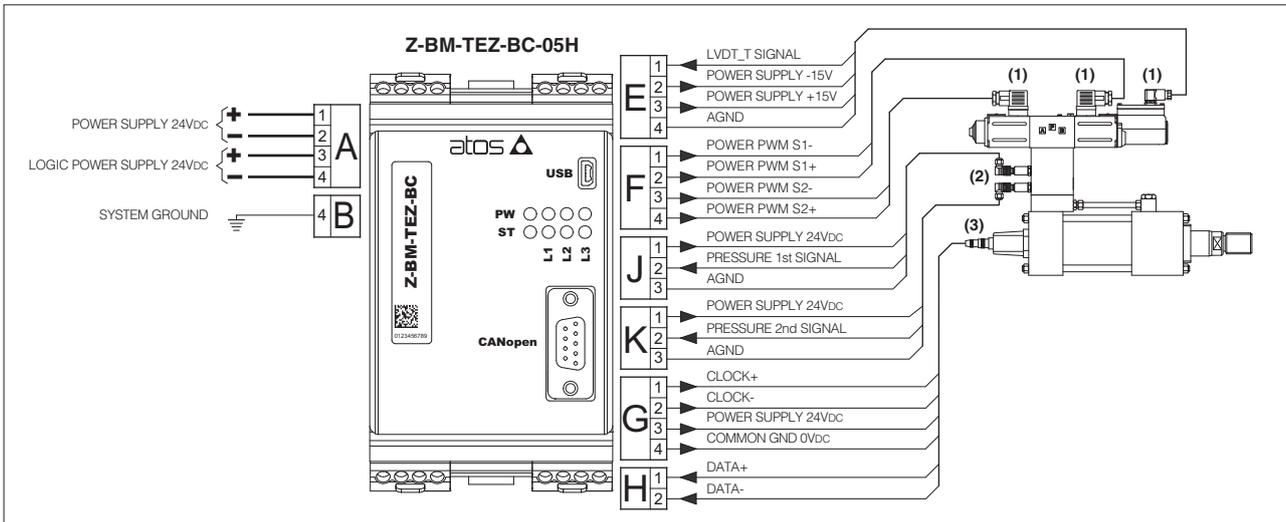
16.1 Position control - analog reference - analog position transducer



(1) For valve electrical connections please refer to the specific technical table

(2) The analog position transducer connections are intended as generic example, for details please consult the transducer's datasheet

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

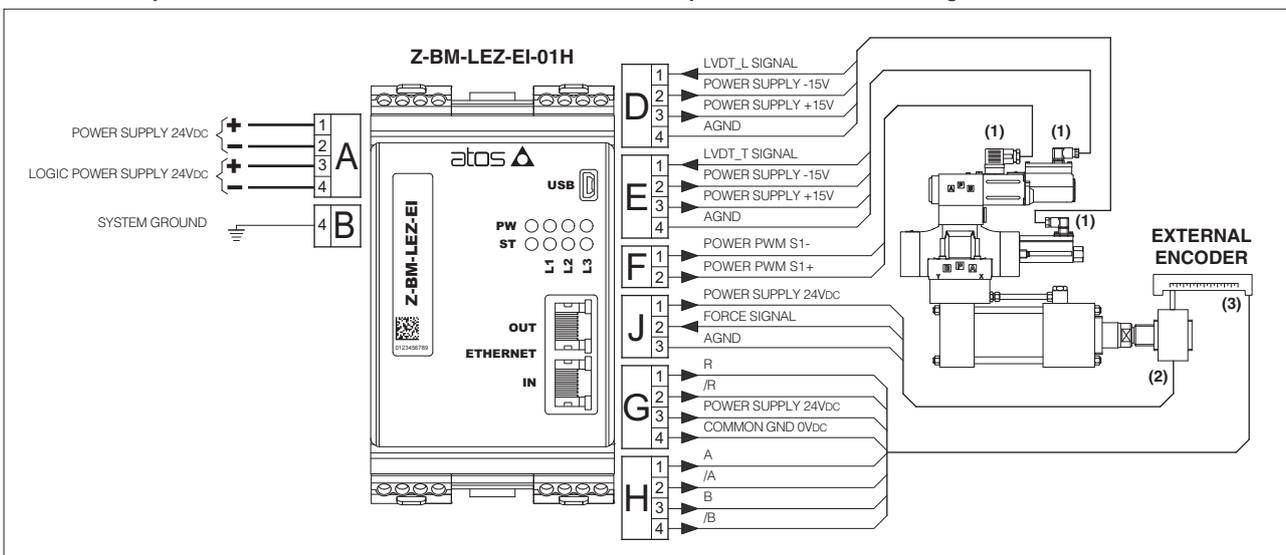


(1) For valve electrical connections please refer to the specific technical table

(2) Pressure transducers connections are shown with voltage signal output; for connections with current signal output see 8.5

(3) The SSI position transducer connections are intended as generic example, for details please consult the transducer's datasheet

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



(1) For valve electrical connections please refer to the specific technical table

(2) Load cell connections is shown with voltage signal output; please consult the load cell datasheet for details about connections

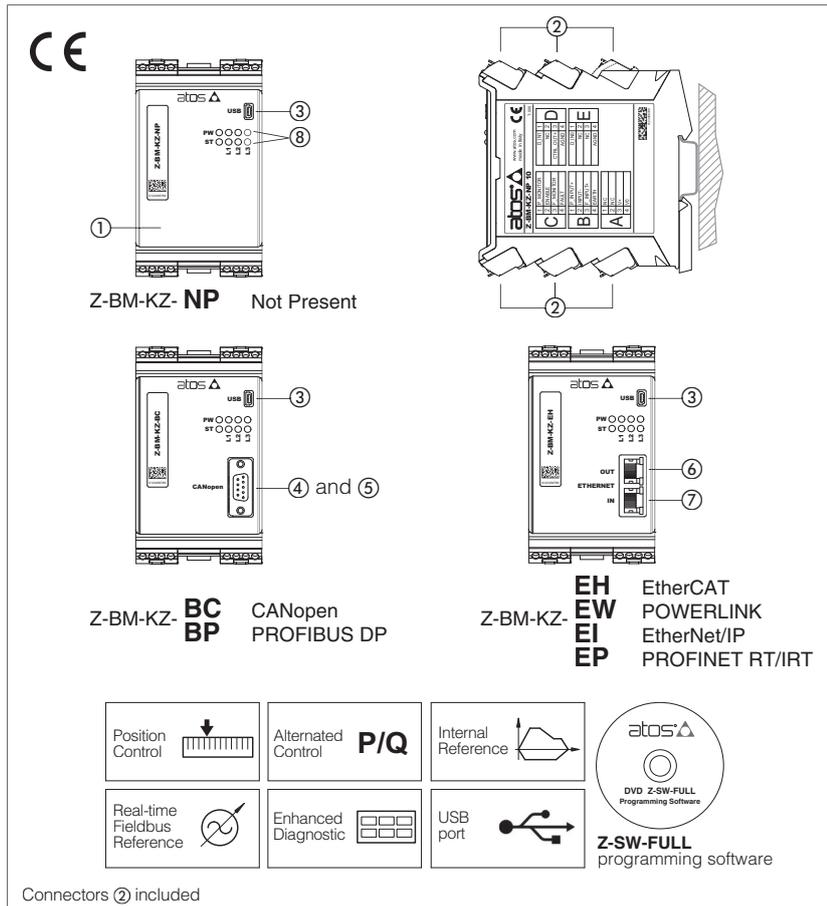
(3) The Encoder position transducer connections are intended as generic example, for details please consult the transducer's datasheet



Table **GS340-2/E**

# Digital Z-BM-KZ axis cards

DIN-rail format, for position and force controls



## Z-BM-KZ

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

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

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

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

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

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

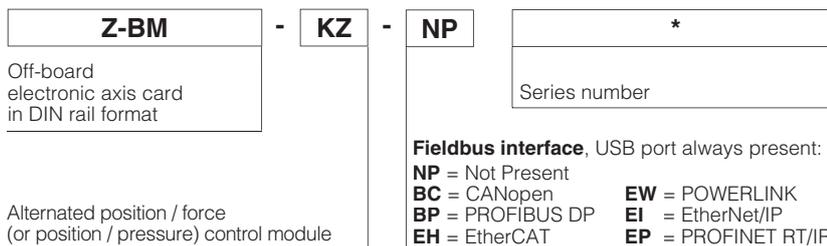
### Electrical Features:

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

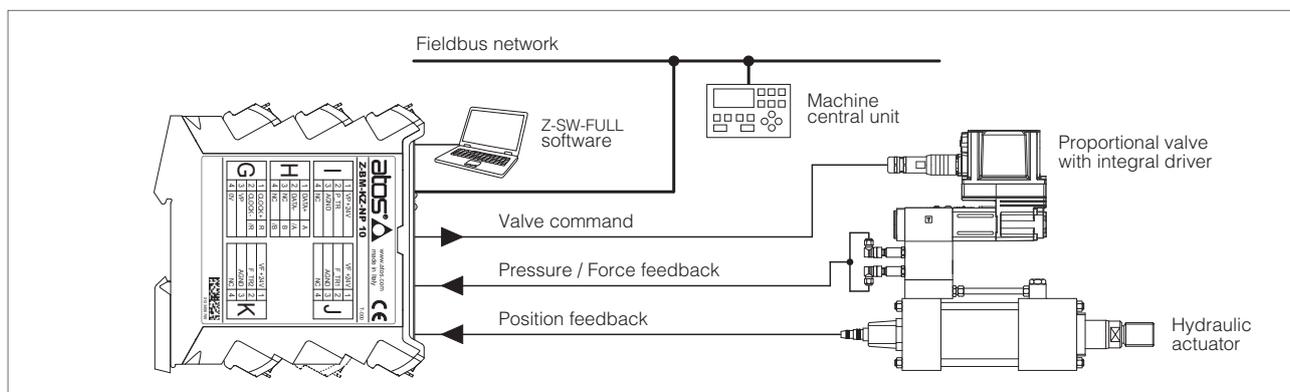
### Software Features:

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

## 1 MODEL CODE



## 2 BLOCK DIAGRAM EXAMPLE



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

3 VALVES RANGE

Valves	Directional					
Standard Data sheet	<b>DHZO-TEB, DKZOR-TEB</b> FS168	<b>DHZO-TES, DKZOR-TES</b> FS168	<b>DLHZO-TEB, DLKZOR-TEB</b> FS180	<b>DLHZO-TES, DLKZOR-TES</b> FS180	<b>DPZO-LEB</b> FS178	<b>DPZO-LES</b> FS178
Ex-proof Data sheet	-	<b>DHZA-TES, DKZA-TES</b> FX135	-	<b>DLHZA-TES, DLKZA-TES</b> FX150	-	<b>DPZA-LES</b> FX235
Controller model	<b>Z-BM-KZ</b>					

4 POSITION REFERENCE MODE

4.1 External reference generation

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

The external reference signal can be software selected among:

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

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

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

4.2 Internal reference generation

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

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

- on-off commands (c)

- fieldbus commands (d)

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

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

Start / stop / switch-over commands examples

*External digital input* on-off commands are used to start/stop the cycle generation or to change the motion phase

*External fieldbus input* on-off commands, by fieldbus communication, are used to start/stop the cycle generation or to change the motion phase

*Switch by position* switch-over from actual to following motion phase occurs when the actual position reaches a programmed value

*Switch by time* switch-over from actual to following motion phase occurs after a fixed time, starting from the actual phase activation

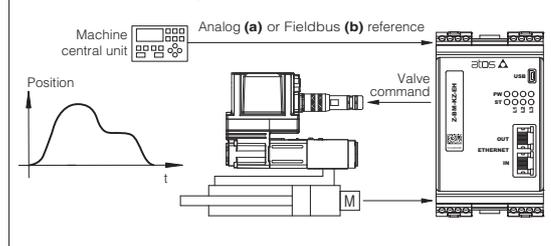
*Switch by internal status* switch-over from internal status are used to start/stop the cycle generation or to change the motion phase

Reference generation types examples

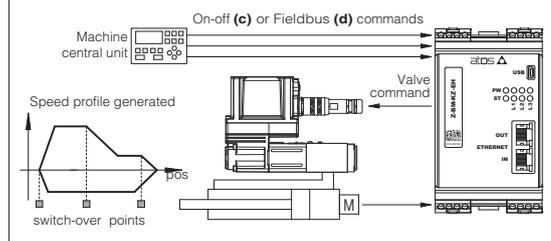
*Absolute* a target position reference signal is internally generated for each motion phase; maximum speed and acceleration can be set to obtain a smooth and precise position control

*Relative* as 'Absolute' but the target position corresponds to the actuator position plus a fixed quote internally set by software

External reference generation



Internal reference generation



5 ALTERNATED POSITION / FORCE CONTROL

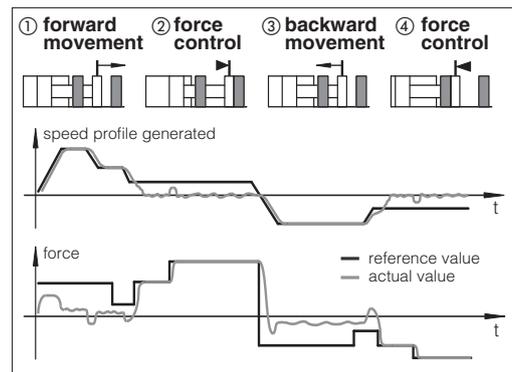
Alternated pressure or force closed loop control can be added to the actuator's standard position control, requiring one or two remote transducers (pressure or force) that have to be installed on the actuator, see below functional schemes.

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

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

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

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



Alternated control configurations - software selectable

SP	SF	SL
one remote pressure transducer has to be installed on the actuator's port to be controlled	two remote pressure transducers have to be installed on the actuator's ports; the actuator force is calculated by the pressure feedbacks (Pa - Pb)	one load cell transducer has to be installed between the actuator and the controlled load
<b>T</b> valve's spool transducer	<b>M</b> actuator's position transducer	<b>P</b> pressure transducer
		<b>L</b> load cell

**SP – position/pressure control**

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

**SF – position/force control**

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

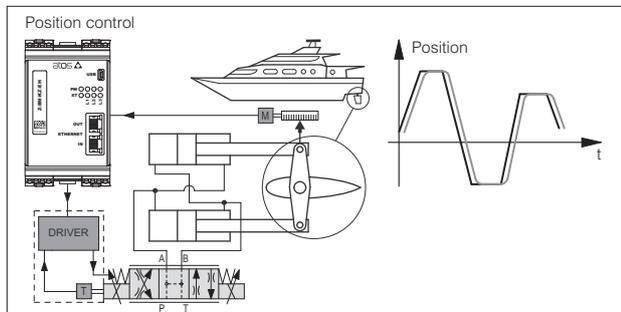
**SL – position/force control**

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

**General Notes:**

- servoproportional type DLHZO, DLKZOR, DPZO-L are strongly recommended for high accuracy applications - see tech tables **FS180, FS178**
- auxiliary check valves are recommended in case of specific hydraulic configuration requirements in absence of power supply or fault - see tech table **EY105**
- for additional information about alternated P/Q controls configuration please refer to tech table **GS002**
- Atos technical service is available for additional evaluations related to specific applications usage

**6 APPLICATION EXAMPLES**

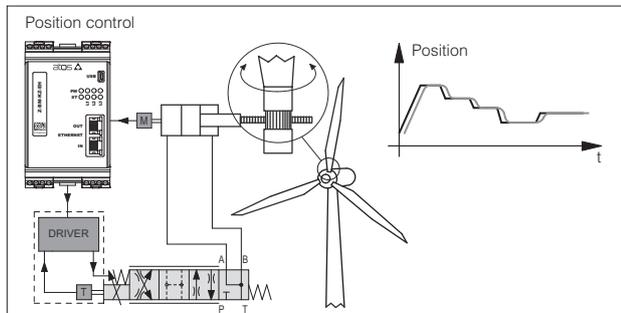


**Hydraulic steering wheel in marine applications**

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

Z-BM-KZ controllers perform the rudder position control system, ensuring accurate and repetitive regulations for a comfortable ride, thanks to:

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

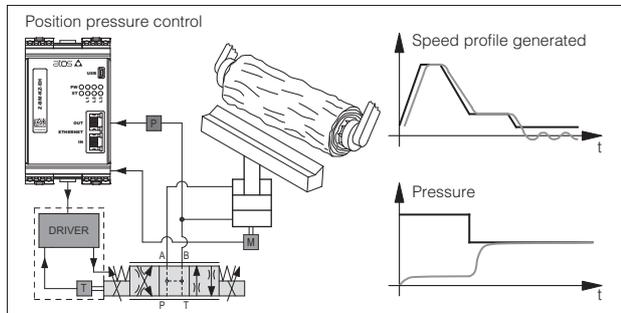


**Wind turbines**

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

Z-BM-KZ controllers perform high quality regulation of the blade pitch simplifying the system architecture, thanks to:

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

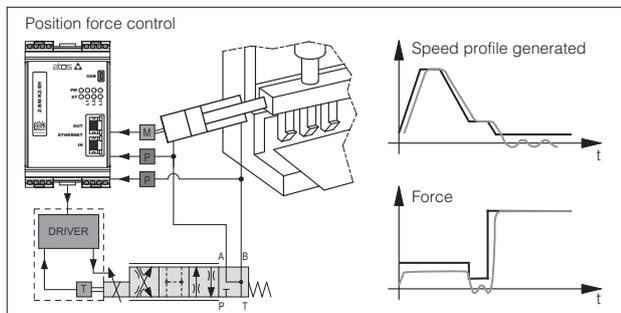


**Wood machinery**

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

Z-BM-KZ controllers allow remote control, thanks to:

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

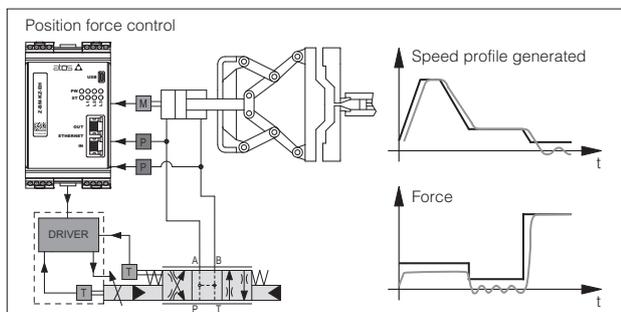


**Bending Machines**

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

Z-BM-KZ controller combine high level position regulation with accurate force control to provide in a single device a complete and dedicated solution, thanks to:

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



**Die-casting machinery**

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

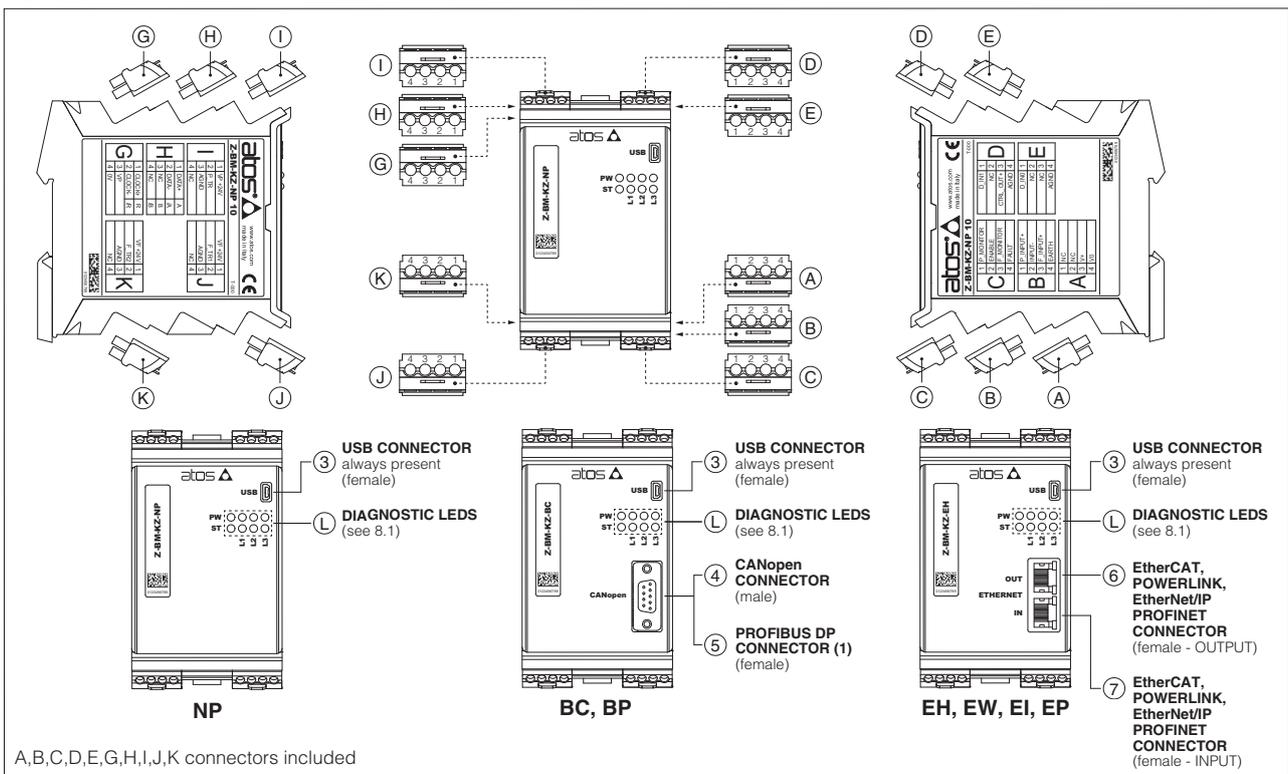
Z-BM-KZ controllers, with alternated position/force control, simplify the hydraulic + electronic system architecture, thanks to:

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

**7 MAIN CHARACTERISTICS**

Power supply (see 9.1)	Nominal : +24 Vdc Rectified and filtered : $V_{RMS} = 20 \div 32 V_{MAX}$ (ripple max 10 % $V_{PP}$ )			
Max power consumption	10 W			
Analog input signals (see 9.2, 9.3)	Voltage: range $\pm 10 Vdc$ (24 $V_{MAX}$ tollerant) Input impedance: $R_i > 50 k\Omega$ Current: range $\pm 20 mA$ Input impedance: $R_i = 500 \Omega$			
Monitor outputs (see 9.4, 9.5) Control output (see 9.10)	Output range: voltage $\pm 10 Vdc$ @ max 5 mA current $\pm 20 mA$ @ max 500 $\Omega$ load resistance			
Enable input (see 9.6) Digital inputs (see 9.11)	Range: 0 $\div$ 5 Vdc (OFF state), 9 $\div$ 24 Vdc (ON state), 5 $\div$ 9 Vdc (not accepted); Input impedance: $R_i > 10 k\Omega$			
Fault output (see 9.7)	Output range: 0 $\div$ 24 Vdc (ON state > [power supply - 2 V] ; OFF state < 1 V ) @ max 50 mA; external negative voltage not allowed (e.g. due to inductive loads)			
Alarms	Cable break with current reference signal, over/under temperature, position control monitoring			
Position transducers power supply	+24 Vdc @ max 100 mA or +5 Vdc @ max 100 mA are software selectable			
Pressure/Force transducers power supply	+24 Vdc @ max 100 mA			
Format	Plastic box ; IP20 protection degree ; L 35 - H 7,5 mm DIN-rail mounting as per EN60715			
Operating temperature	-20 $\div$ +50 $^{\circ}C$ (storage -25 $\div$ +85 $^{\circ}C$ )			
Mass	Approx. 450 g			
Additional characteristics	8 leds for diagnostic; protection against reverse polarity of power supply			
Electromagnetic compatibility (EMC)	According to Directive 2014/30/UE (Immunity: EN 61000-6-2; Emission: EN 61000-6-3)			
Compliance	RoHs Directive 2011/65/EU as last update by 2015/65/EU REACH Regulation (EC) n°1907/2006			
Communication interface	USB Atos ASCII coding	CANopen EN50325-4 + DS408	PROFIBUS DP EN50170-2/IEC61158	EtherCAT, POWERLINK, EtherNet/IP, PROFINET IO RT / IRT EC 61158
Communication physical layer	not insulated USB 2.0 + USB OTG	optical insulated CAN ISO11898	optical insulated RS485	Fast Ethernet, insulated 100 Base TX
Recommended wiring cable	LiYCY shielded cables: 0,5 mm <sup>2</sup> max 50 m for logic - 1,5 mm <sup>2</sup> max 50 m for power supply Note: for transducers wiring cable please consult the transducers datasheet			
Max conductor size (see 14)	2,5 mm <sup>2</sup>			

**8 CONNECTIONS AND LEDS**



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

**8.1 Diagnostic LEDs (L)**

Eight leds show controller operative conditions for immediate basic diagnostics. Please refer to the controller user manual for detailed information.

FIELDBUS LEDS	NP Not Present	BC CANopen	BP PROFIBUS DP	EH EtherCAT	EW POWERLINK	EI EtherNet/IP	EP PROFINET	PW L1 L2 L3
L1		VALVE STATUS			LINK/ACT			
L2		NETWORK STATUS			NETWORK STATUS			
L3		ALARM STATUS			LINK/ACT			
PW	OFF = Power supply OFF	ON = Power supply ON						
ST	OFF = Fault present	ON = No fault						

## 8.2 Connectors - 4 pin

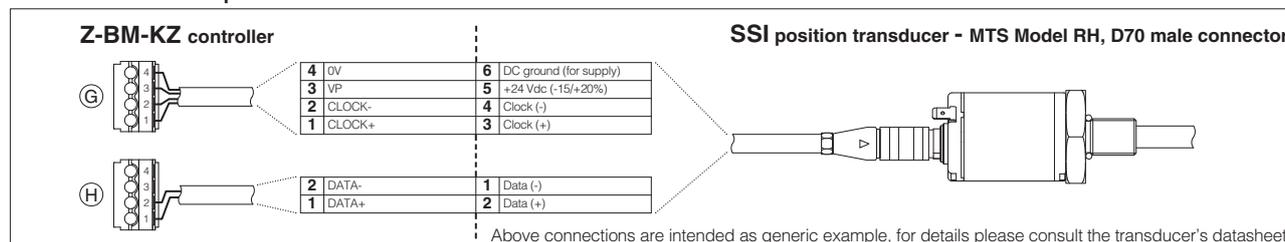
CONNECTOR	PIN	SIGNAL	TECHNICAL SPECIFICATIONS	NOTES
A	A1	NC	Do not connect	
	A2	NC	Do not connect	
	A3	V+	Power supply 24 Vdc (see 9.1)	Input - power supply
	A4	V0	Power supply 0 Vdc (see 9.1)	Gnd - power supply
B	B1	P_INPUT+	Position reference input signal: $\pm 10$ Vdc / $\pm 20$ mA maximum range;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

8.3 SSI connectors signals - 4 pin

<b>G</b>	G1	<b>CLOCK+</b>	Serial synchronous clock (+)	Output - on/off signal
	G2	<b>CLOCK-</b>	Serial synchronous clock (-)	Output - on/off signal
	G3	<b>VP</b>	Power supply: +24Vdc, +5Vdc or OFF (default OFF)	Output - power supply <b>Software selectable</b>
	G4	<b>0V</b>	Common gnd for transducer power and signals	Common gnd
<b>H</b>	H1	<b>DATA+</b>	Serial position data (+)	Input - on/off signal
	H2	<b>DATA-</b>	Serial position data (-)	Input - on/off signal
	H3	<b>NC</b>	Do not connect	
	H4	<b>NC</b>	Do not connect	

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

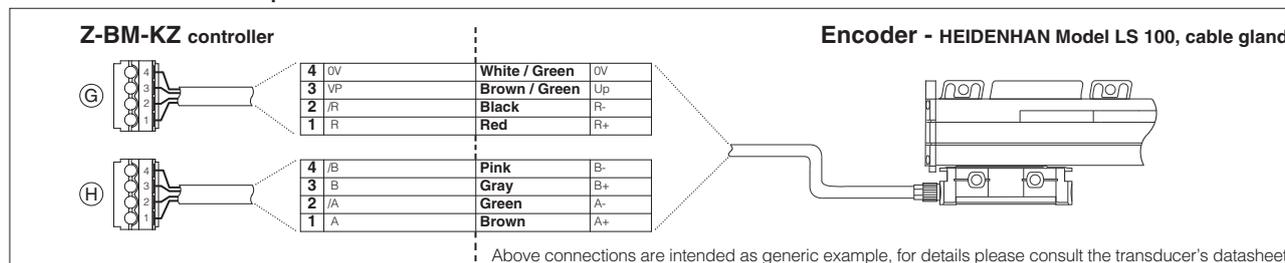
SSI connection - example



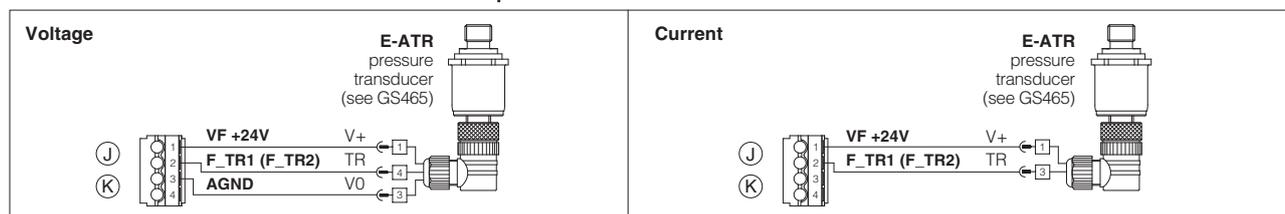
8.4 Encoder connectors signals - 4 pin

<b>G</b>	G1	<b>R</b>	Input channel R	Input - on/off signal
	G2	<b>/R</b>	Input channel /R	Input - on/off signal
	G3	<b>VP</b>	Power supply: +24Vdc, +5Vdc or OFF (default OFF)	Output - power supply <b>Software selectable</b>
	G4	<b>0V</b>	Common gnd for transducer power and signals	Common gnd
<b>H</b>	H1	<b>A</b>	Input channel A	Input - on/off signal
	H2	<b>/A</b>	Input channel /A	Input - on/off signal
	H3	<b>B</b>	Input channel B	Input - on/off signal
	H4	<b>/B</b>	Input channel /B	Input - on/off signal

Encoder connection - example



8.5 Pressure/force transducers connection - example



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

③ **USB connector - Mini USB type B** always present

PIN	SIGNAL	TECHNICAL SPECIFICATION (1)
1	<b>+5V_USB</b>	Power supply
2	<b>D-</b>	Data line -
3	<b>D+</b>	Data line +
4	<b>ID</b>	Identification
5	<b>GND_USB</b>	Signal zero data line

⑤ **BP fieldbus execution, connector - DB9 - 9 pin**

PIN	SIGNAL	TECHNICAL SPECIFICATION (1)
1	<b>SHIELD</b>	
3	<b>LINE-B</b>	Bus line (low)
5	<b>DGND</b>	Data line and termination signal zero
6	<b>+5V</b>	Termination supply signal
8	<b>LINE-A</b>	Bus line (high)

④ **BC fieldbus execution, connector - DB9 - 9 pin**

PIN	SIGNAL	TECHNICAL SPECIFICATION (1)
2	<b>CAN_L</b>	Bus line (low)
3	<b>CAN_GND</b>	Signal zero data line
5	<b>CAN_SHLD</b>	Shield
7	<b>CAN_H</b>	Bus line (high)

⑥ ⑦ **EH, EW, EI, EP fieldbus execution, connector - RJ45 - 8 pin**

PIN	SIGNAL	TECHNICAL SPECIFICATION (1)
1	<b>TX+</b>	Transmitter - white/orange
2	<b>RX+</b>	Receiver - white/green
3	<b>TX-</b>	Transmitter - orange
6	<b>RX-</b>	Receiver - green

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

## 9 SIGNALS SPECIFICATIONS

Atos digital controllers are CE marked according to the applicable directives (e.g. Immunity/Emission EMC Directive).

Installation, wirings and start-up procedures must be performed according to the prescriptions shown in tech table **F003** and in the user manuals included in the Z-SW programming software.

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

### 9.1 Power supply (V+ and V0)

The power supply must be appropriately stabilized or rectified and filtered: apply at least a 10000  $\mu$ F/40 V capacitance to single phase rectifiers or a 4700  $\mu$ F/40 V capacitance to three phase rectifiers.



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

### 9.2 Position reference input signal (P\_INPUT+)

Functionality of P\_INPUT+ signal (pin B1), depends on controllers' reference mode, see section [4](#) :

*external analog reference generation* (see 4.1): input is used as reference for the controller axis position closed loop.

Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of  $\pm 10$  V<sub>DC</sub> or  $\pm 20$  mA; default is  $\pm 10$  V<sub>DC</sub>

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

### 9.3 Pressure or force reference input signal (F\_INPUT+)

Functionality of F\_INPUT+ signal (pin B3), depends on selected controllers' reference mode and alternated control options, see section [5](#) :

*SP, SL, SF controls and external analog reference selected* : input is used as reference for the controller pressure/force closed loop.

Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of  $\pm 10$  V<sub>DC</sub> or  $\pm 20$  mA; default is  $\pm 10$  V<sub>DC</sub>

*SN control or fieldbus/internal reference selected*: analog reference input signal can be used as on-off commands with input range 0 ÷ 24 V<sub>DC</sub>

### 9.4 Position monitor output signal (P\_MONITOR)

The controller generates an analog output signal (pin C1) proportional to the actual axis position; the monitor output signal can be software set to show other signals available in the controller (e.g. analog reference, fieldbus reference, position error, valve spool position).

The output range and polarity are software selectable within the maximum range  $\pm 10$  V<sub>DC</sub> or  $\pm 20$  mA; default is  $\pm 10$  V<sub>DC</sub>

### 9.5 Pressure or force monitor output signal (F\_MONITOR)

The controller generates an analog output signal (pin C3) according to alternated pressure/force control option:

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

*SP, SL, SF controls*: output signal is proportional to the actual pressure/force 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  $\pm 10$  V<sub>DC</sub> or  $\pm 20$  mA; default is  $\pm 10$  V<sub>DC</sub>

### 9.6 Enable Input Signal (ENABLE)

To enable the controller, a 24 V<sub>DC</sub> voltage has to be applied on pin C2.

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

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

### 9.7 Fault output signal (FAULT)

Fault output signal (pin C4) indicates fault conditions of the controller (solenoid short circuits/not connected, reference or transducer signal cable broken, maximum error exceeded, etc.). Fault presence corresponds to 0 V<sub>DC</sub>, normal working corresponds to 24 V<sub>DC</sub>

Fault status is not affected by the status of the Enable input signal.

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

### 9.8 Position transducer input signals

A position transducer must be always directly connected to the controller. Position digital input signals are factory preset to binary SSI, they can be reconfigured via software selecting between binary/gray SSI, Encoder or generic transducer with analog interface.

Input signals can be reconfigured via software selecting between voltage and current, within a maximum range of  $\pm 10$  V<sub>DC</sub> or  $\pm 20$  mA; default is  $\pm 10$  V<sub>DC</sub>

Refer to position transducer characteristics to select the transducer type according to specific application requirements, see section [10](#) .

### 9.9 Remote pressure/force transducer input signals (F\_TR1 and F\_TR2) - SP, SF, SL controls

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

Input signal can be reconfigured via software selecting between voltage and current, within a maximum range of  $\pm 10$  V<sub>DC</sub> or  $\pm 20$  mA; default is  $\pm 10$  V<sub>DC</sub>

Refer to pressure/force transducer characteristics to select the transducer type according to specific application requirements, see section [10](#) .

### 9.10 Control output signal (CTRL\_OUT+)

The error signal processed by the control algorithms generates the control output signal (pin D3) for the external driver of the proportional valve which operates the hydraulic flow to the actuator.

The output range and polarity are software selectable within  $\pm 10$  V<sub>DC</sub> (for voltage) or  $\pm 20$  mA (for current) maximum range referred to the analog ground AGND on pin D4; default setting is  $\pm 10$  V<sub>DC</sub>

### 9.11 Digital input signals (D\_IN0 and D\_IN1)

Two on-off input signals are available on the pin E1 and D1. For each input by the Z-SW software, it is possible to set the polarity and to match a proper condition within the following:

- pressure/force PID selection (default)
- start/stop/switch-over command in case of internal reference generation (see 4.2)
- specific operative command for hydraulic axis mode (referencing mode, jog mode, automatic mode)
- jog command
- disable pressure / force alternated control

PIN	PID SET SELECTION			
	SET 1	SET 2	SET 3	SET 4
E1	0	24 V <sub>DC</sub>	0	24 V <sub>DC</sub>
D1	0	0	24 V <sub>DC</sub>	24 V <sub>DC</sub>

**10 ACTUATOR'S TRANSDUCER CHARACTERISTICS****10.1 Position transducers**

The accuracy of the position control is strongly dependent to the selected position transducer. Four different transducer interfaces are available on the controllers, depending to the system requirements: analog signal (analog), SSI or Encoder (digital).

Transducers with digital interface allow high resolution and accurate measures, that combined with fieldbus communication grants highest performances. Transducers with analog interface grant simple and cost effective solutions.

**10.2 Pressure/force transducers**

The accuracy of the pressure/force control is strongly dependent to the selected pressure/force transducer (see section 5). Alternated pressure/force controls require to install pressure transducers or load cell to measure the actual pressure/force values.

Pressure transducers allow easy system integration and cost effective solution for both alternated position/pressure and position/force controls (see tech table **GS465** for pressure transducers details). Load cell transducers allow the user to get high accuracy and precise regulations for alternated position/force control.

The characteristics of the remote pressure/force transducers must be always selected to match the application requirements and to obtain the best performances: transducer nominal range should be at least 115%÷120% of the maximum regulated pressure/force.

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

Input type	Position			Pressure/Force
	Analog	SSI (3)	Incremental Encoder	Analog
Power supply (1)	+24 V <sub>DC</sub>	+5 V <sub>DC</sub> or +24 V <sub>DC</sub>	+5 V <sub>DC</sub> or +24 V <sub>DC</sub>	+24 V <sub>DC</sub>
Controller Interface	0 ÷ 10V or 4 ÷ 20 mA	Serial SSI binary/gray	TTL 5V <sub>pp</sub> - 150 KHz	±10 V <sub>DC</sub> or 4 ÷ 20 mA
Max speed	1 m/s	2 m/s	2 m/s	-
Max Resolution	< 0.2 % FS	1 µm	1 µm (@ 0.15 m/s)	< 0.4 % FS
Linearity error (2)	< ±0.03% FS	< ± 0.01 % FS	< ± 0.001 % FS	< ±0.25% FS
Repeatability (2)	< ± 0.005% FS	< ± 0.001 % FS	< ± 0.001 % FS	< ±0.1% FS

(1) power supply provided by Atos controller (2) percentage of total stroke (3) for Balluff BTL7 with SSI interface only special code SA433 is supported

**11 VALVE SETTINGS AND PROGRAMMING TOOLS**

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

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

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

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

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

DVD programming software, to be ordered separately:

**Z-SW-FULL** DVD first supply = software has to be activated via web registration at [www.atos.com](http://www.atos.com) ; 1 year service included  
 Upon web registration user receive via email the Activation Code (software license) and login data to access Atos Download Area

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

**Atos Download Area:** direct access to latest releases of Z-SW software, manuals, USB drivers and fieldbus configuration files at [www.atos.com](http://www.atos.com)

**USB Adapters, Cables and Terminators, can be ordered separately**

**12 MAIN SOFTWARE PARAMETER SETTINGS**

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

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

**12.1 External reference and transducer parameters**

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

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

**12.2 PID control dynamics parameters**

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

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

**12.3 Monitoring parameters**

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

- *Monitoring parameters* maximum allowed errors can be set for both static and dynamic positioning phases, and dedicated waiting times can be set to delay the activation of the alarm condition and relevant reaction (see 12.4)

**12.4 Fault parameters**

Allow to configure how the controller detect and react to alarm conditions:

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

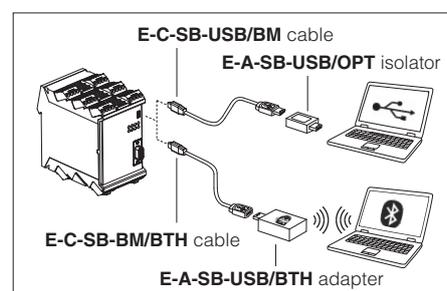
**12.5 Valve characteristics compensation**

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

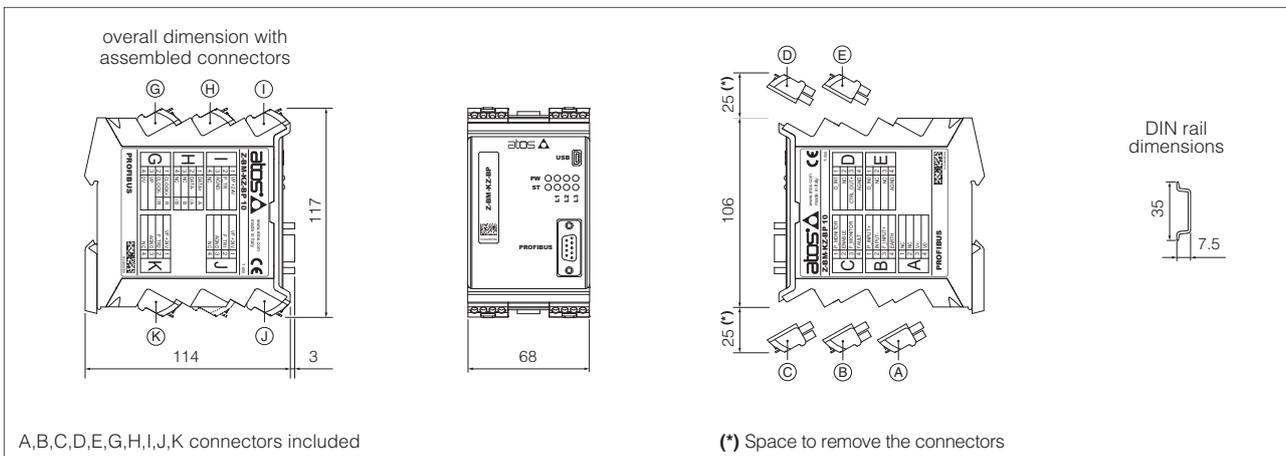
- *Valve parameters* modify the standard valve regulation by means of deadband compensation, curve linearization and differentiated gain for positive and negative regulation

**12.6 Motion phases parameters**

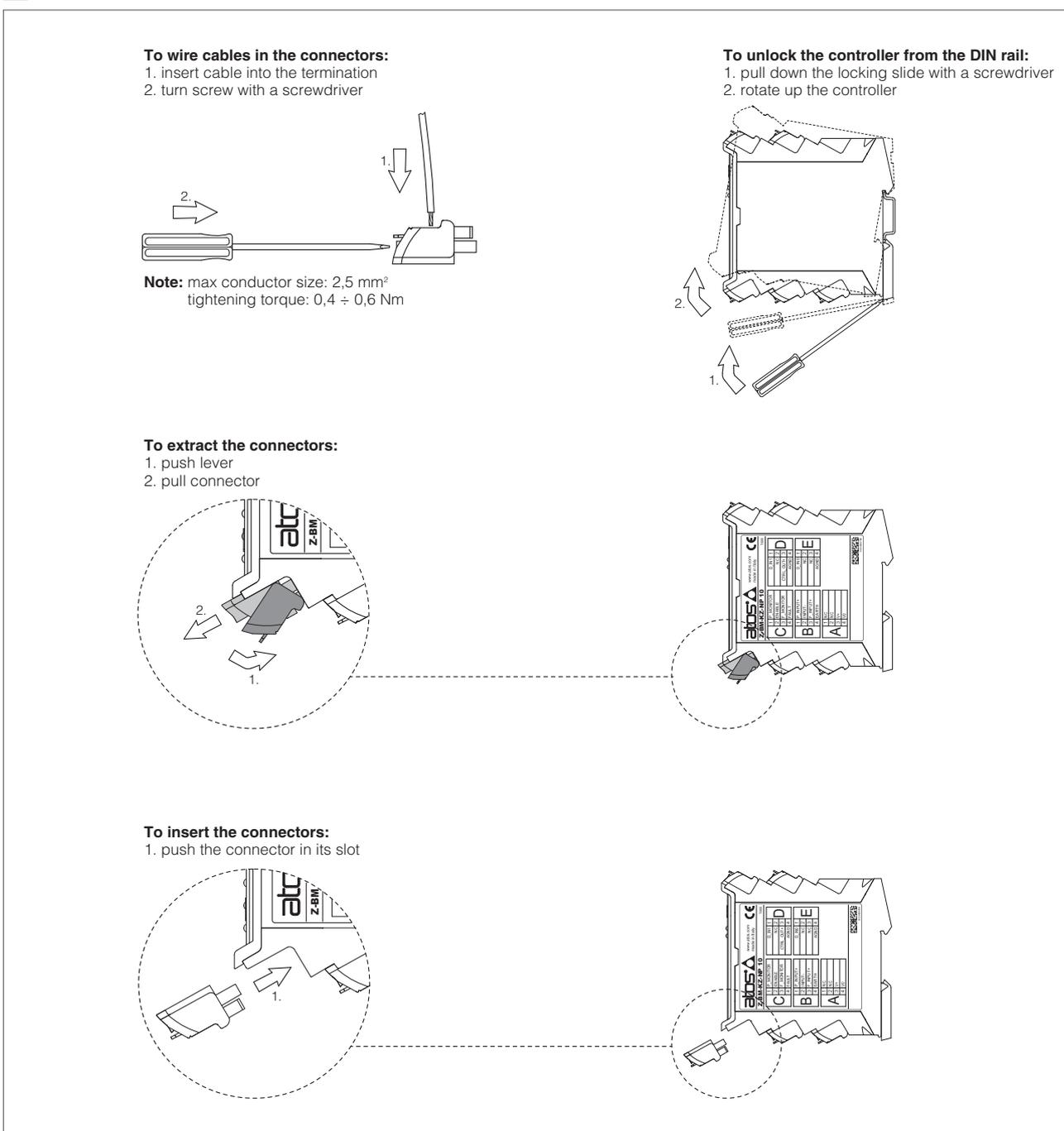
When the internal reference generation is active a pre-programmed cycle can be generated; start/stop/switch-over commands and reference generation types parameters can be set to design a customized sequence of motion phases adapted to the specific application requirements (see 4.2).

**USB or Bluetooth connection**

13 OVERALL DIMENSIONS [mm]



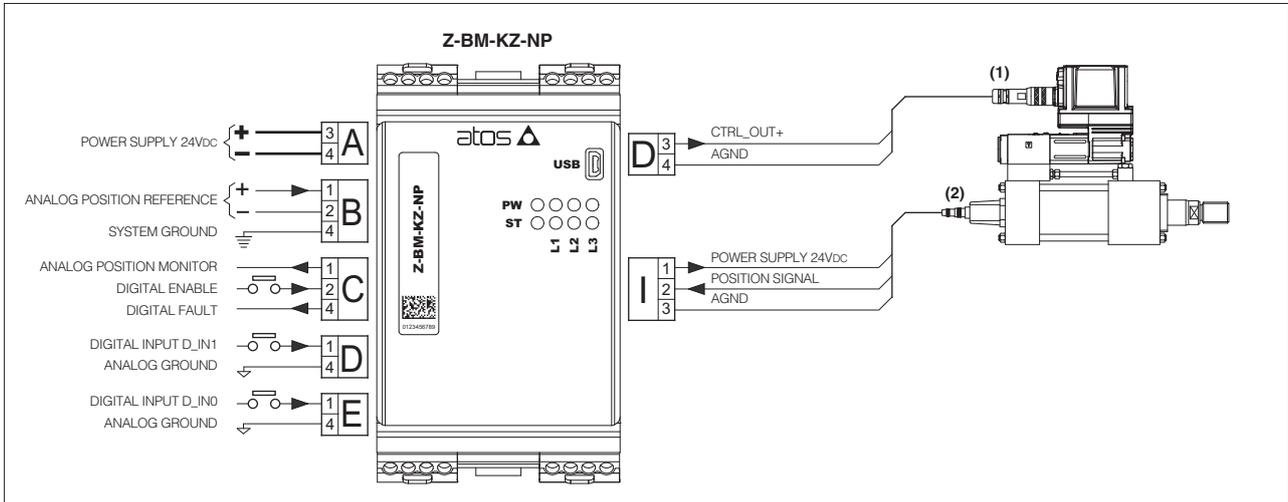
14 INSTALLATION



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

15 WIRING EXAMPLES

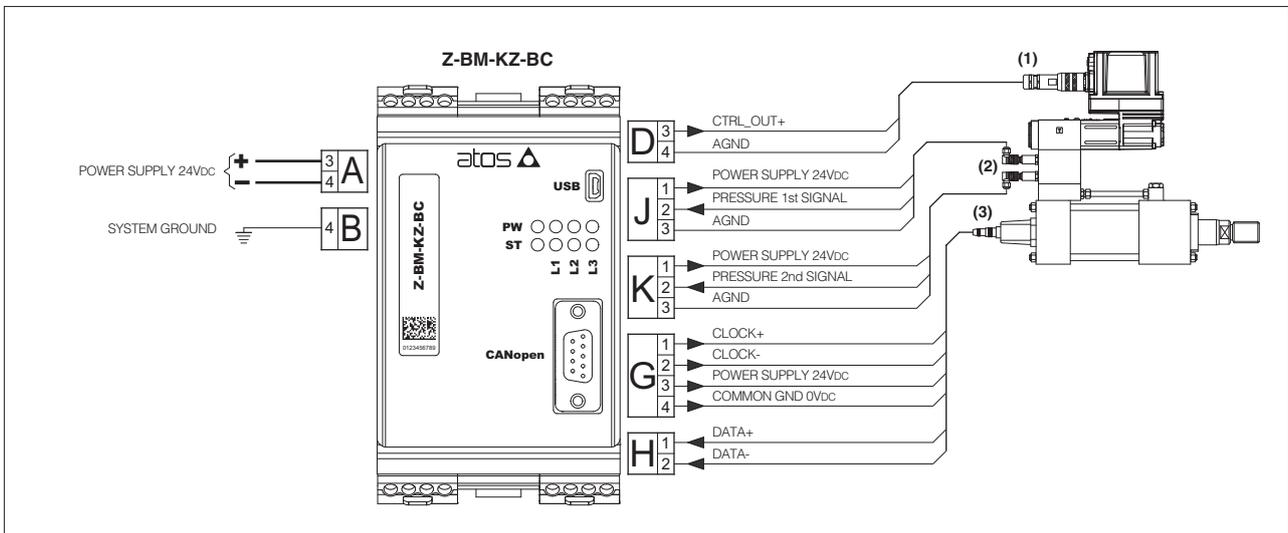
15.1 Position control - analog reference - analog position transducer



(1) For valve driver electrical connections please refer to the specific technical table

(2) The analog position transducer connections are intended as generic example, for details please consult the transducer's datasheet

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

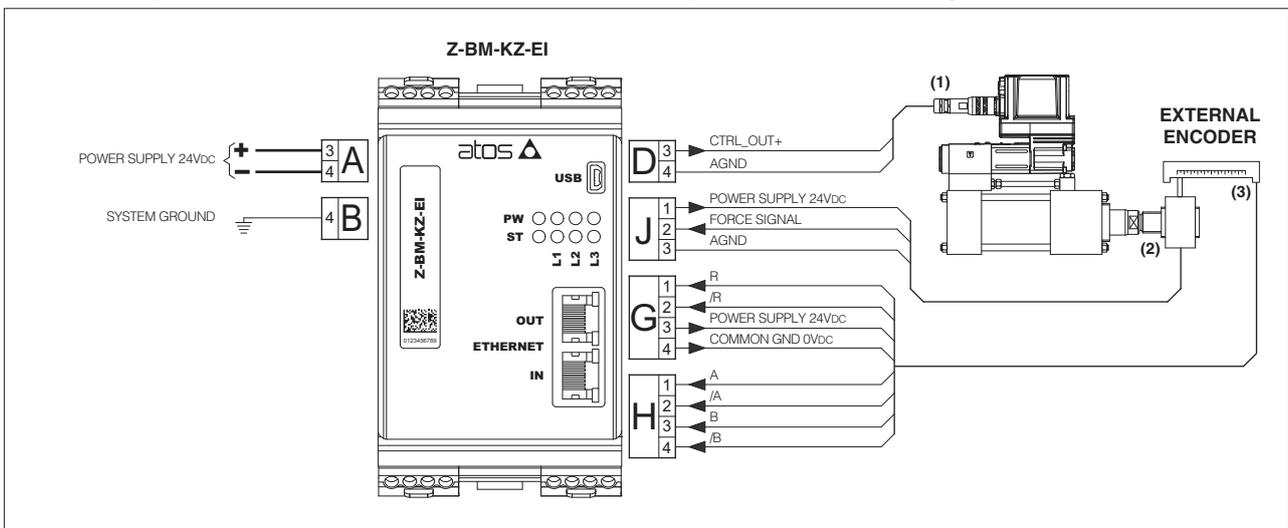


(1) For valve driver electrical connections please refer to the specific technical table

(2) Pressure transducers connections are shown with voltage signal output; for connections with current signal output see 8.5

(3) The SSI position transducer connections are intended as generic example, for details please consult the transducer's datasheet

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



(1) For valve driver electrical connections please refer to the specific technical table

(2) Load cell connections is shown with voltage signal output; please consult the load cell datasheet for details about connections

(3) The Encoder position transducer connections are intended as generic example, for details please consult the transducer's datasheet