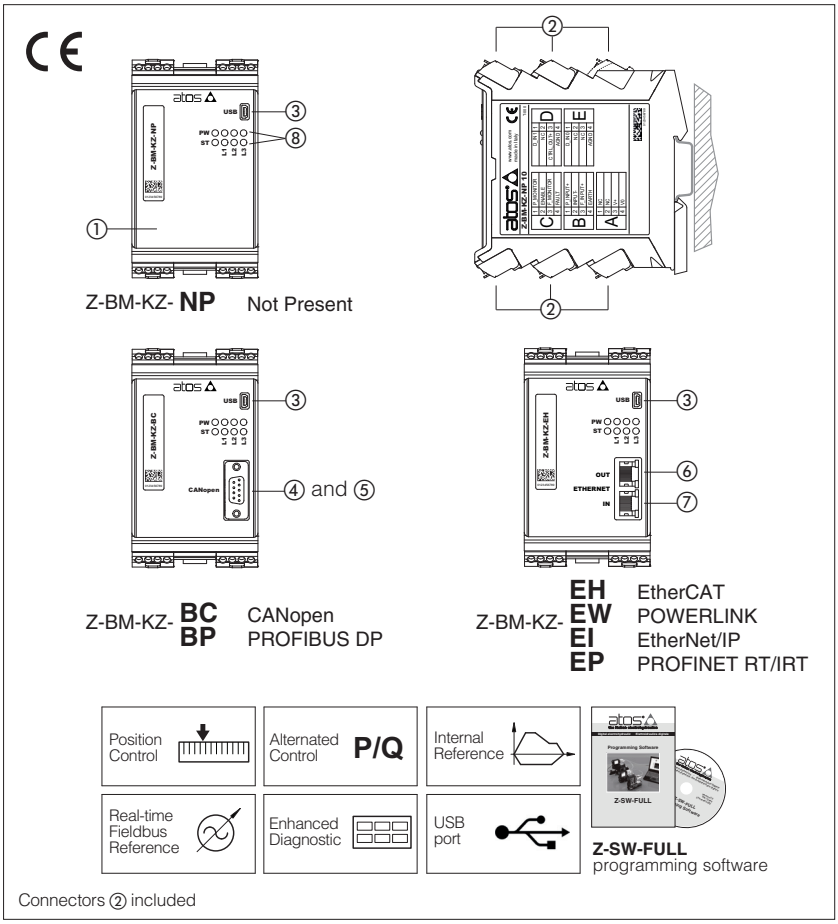
# Digital Z-BM-KZ position controllers

DIN-rail panel format, for electrohydraulic closed loop controls




## Z-BM-KZ

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

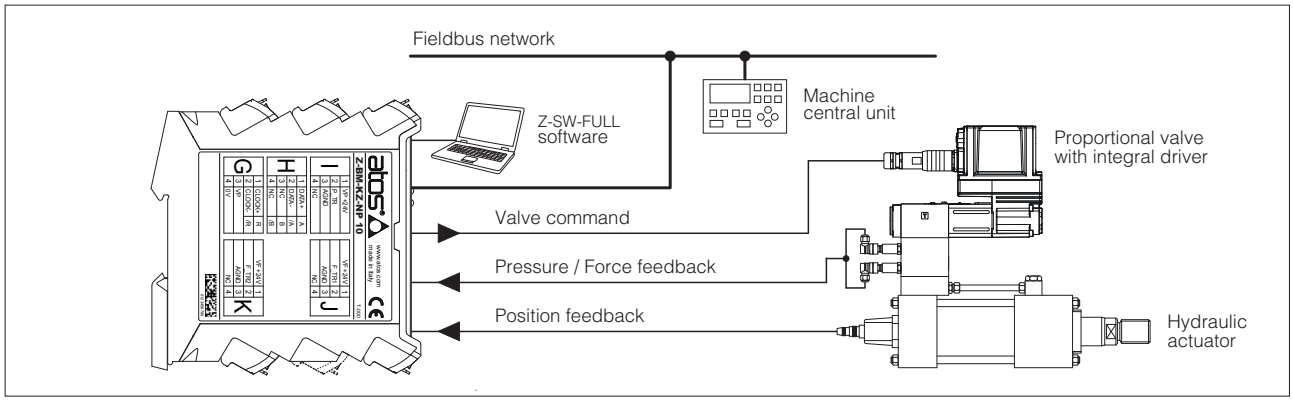
**Software Features:**

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

## 1 MODEL CODE

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

## 2 BLOCK DIAGRAM EXAMPLE




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

## 3 VALVES RANGE

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

## 4 POSITION REFERENCE MODE

### 4.1 External reference generation

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

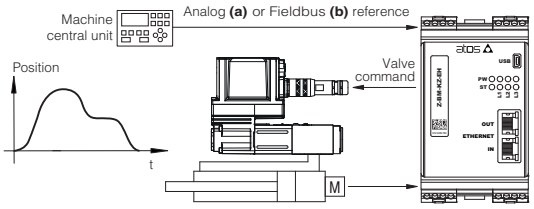
The external reference signal can be software selected among:

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

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

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

**External reference generation**




### 4.2 Internal reference generation

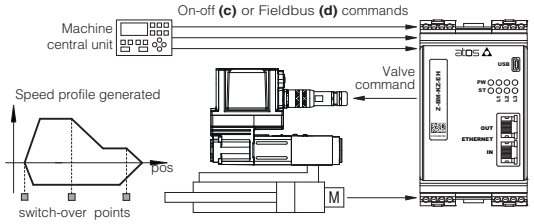
Axis controller regulates in closed loop the actuator position according to an internally generated reference position signal and to the position feedback from the actuator transducer.It generates a reference signal for the proportional valve which regulates the hydraulic flow to the actuator.

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

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

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

**Internal reference generation**




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

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

**Start / stop / switch-over commands examples**

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

**Reference generation types examples**

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

## 5 ALTERNATED POSITION / FORCE CONTROL

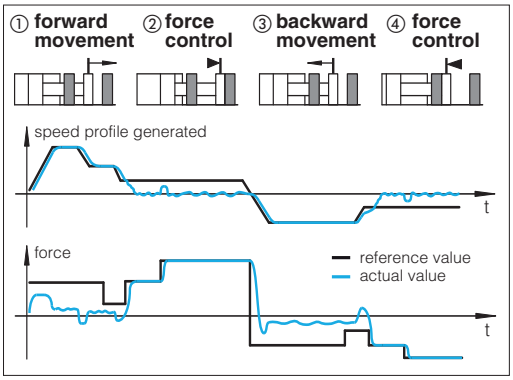
Alternated pressure or force closed loop control can be added to the actuator's standard position control, requiring one or two remote transducers (pressure or force) that have to be installed on the actuator, see below functional schemes.

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

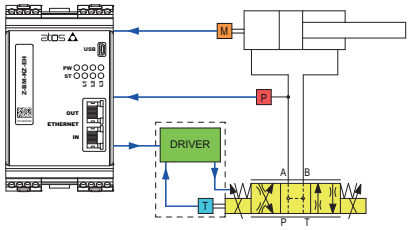
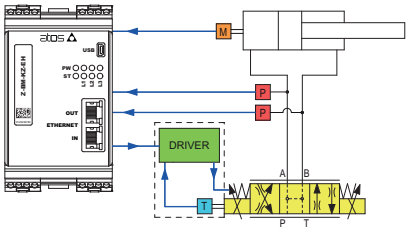
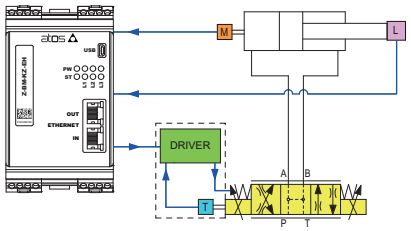
The dynamics of the switching between the two controls can be regulated thanks to specific software setting, in order to avoid instability and vibrations.

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

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




**Alternated control configurations** - software selectable

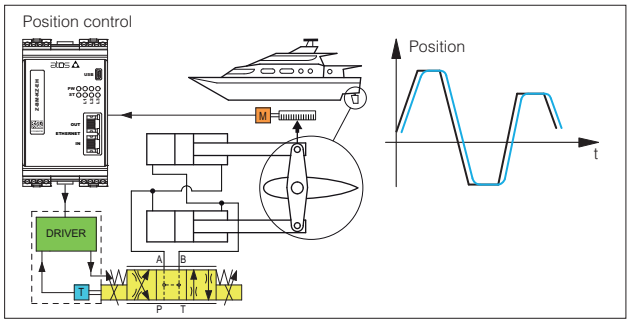
| SP | SF | SL |
|---|---|---|
|  |  |  |
| one remote pressure transducer has to be installed on the actuator's port to be controlled | two remote pressure transducers have to be installed on the actuator's ports; the actuator force is calculated by the pressure feedbacks (Pa - Pb) | one load cell transducer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



T valve's spool transducer — M actuator's position transducer — P pressure transducer — L load cell

**SP – position/pressure control**
Adds pressure control to standard position control and permits to limit the max force in one direction controlling in closed loop the pressure acting on one side of the hydraulic actuator. A single pressure transducer has to be installed on hydraulic line to be controlled.
**SF – position/force control**
Adds force control to standard position control and permits to limit the max force in two directions controlling in closed loop the delta pressure acting on both sides of the hydraulic actuator. Two pressure transducers have to be installed on both hydraulic line.
**SL – position/force control**
Adds force control to standard position control and permits to limit the max force in one or two directions controlling in closed loop the force performed by the hydraulic actuator. A load cell has to be installed on hydraulic actuator.
**General Notes:**
- servoproportional type DLHZO, DLKZOR, DPZO-L are strongly recommended for high accuracy applications - see tech tables **FS180**, **FS178**
- auxiliary check valves are recommended in case of specific hydraulic configuration requirements in absence of power supply or fault - see tech table **EY105**
- for additional information about alternated P/Q controls configuration please refer to tech table **GS002**
- Atos technical service is available for additional evaluations related to specific applications usage

## 6 APPLICATION EXAMPLES

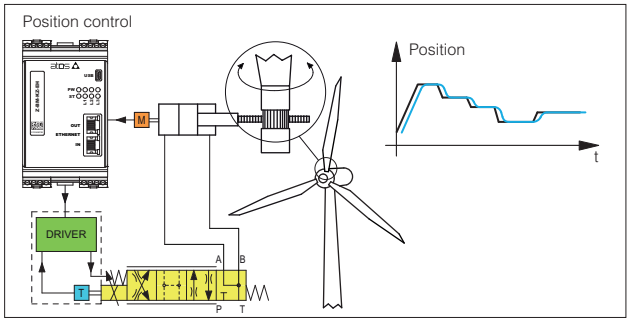



### Hydraulic steering wheel in marine applications

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

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

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

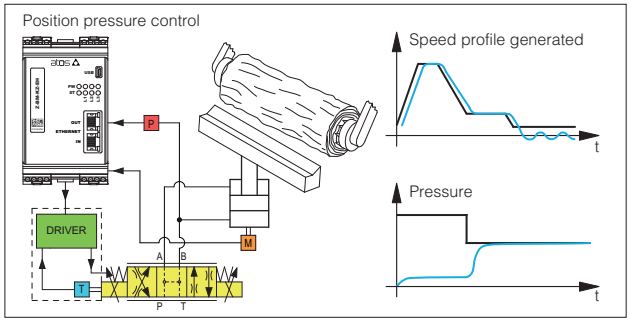



### Wind turbines

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

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

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

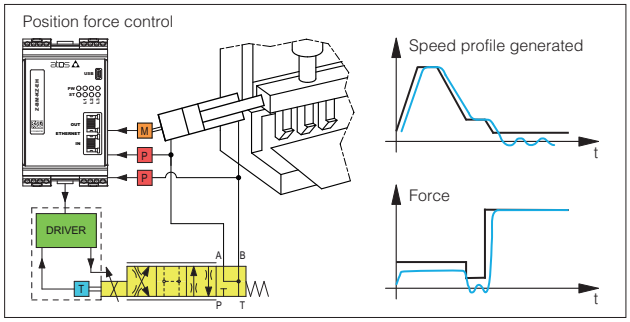



### Wood machinery

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

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

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

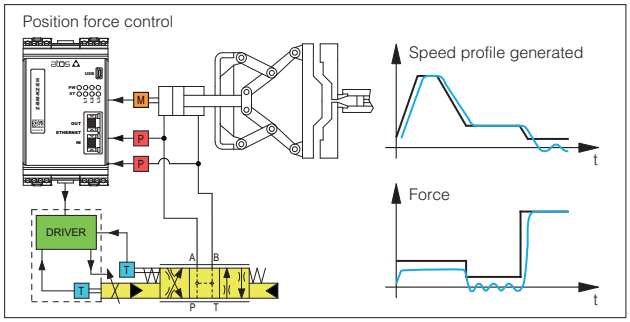



### Bending Machines

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

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

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




### Die-casting machinery

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

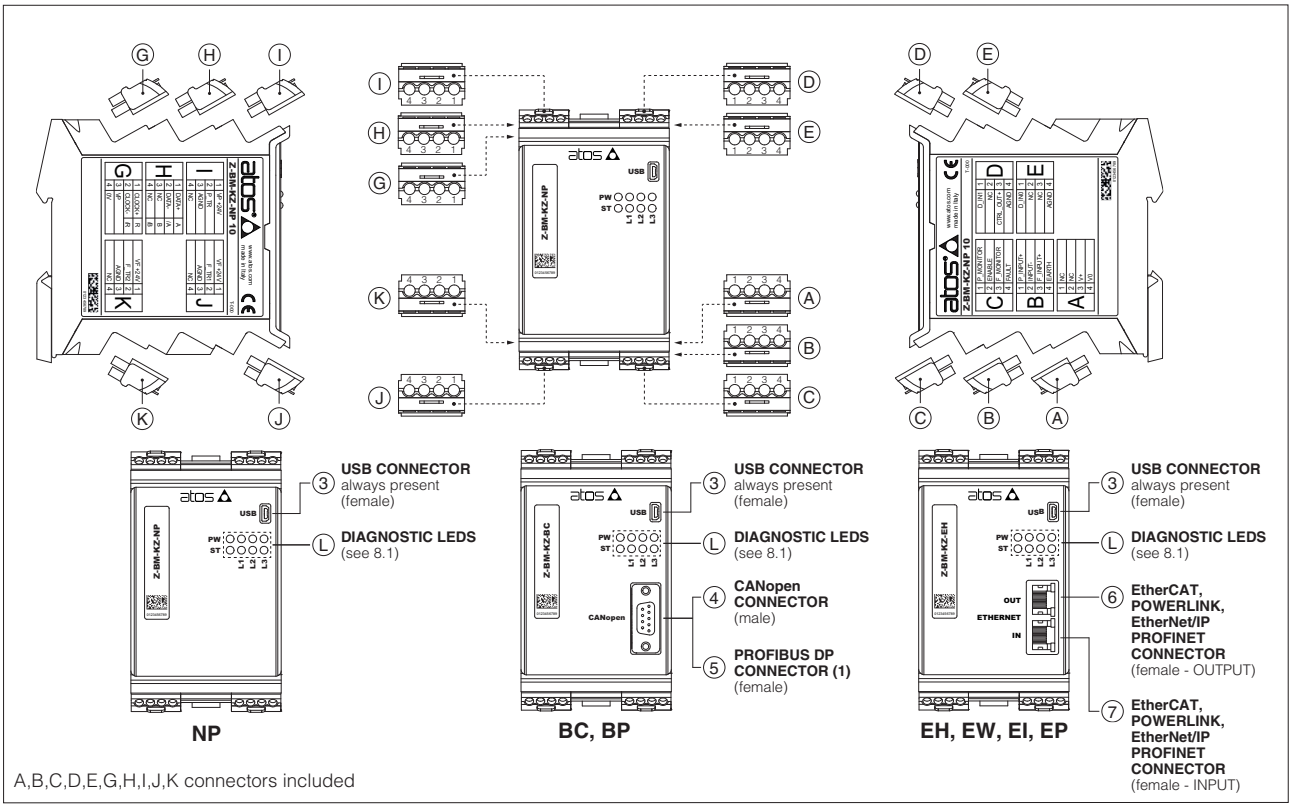
Z-BM-KZ controllers, with alternated position/force control, simplify the hydraulic + electronic system architecture, thanks to:

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

## 7 MAIN CHARACTERISTICS

| | | | | | |
|---|---|---|---|---|---|
| Power supply | (see 9.1) | Nominal : +24 VDC<br>Rectified and filtered : VRMS = 20 ÷ 32 VMAX (ripple max 10 % VPP) | | | |
| Max power consumption | | 10 W | | | |
| Analog input signals | (see 9.2, 9.3) | Voltage: range ±10 VDC (24 VMAX tollerant) Input impedance: Ri > 50 kΩ<br>Current: range ±20 mA Input impedance: Ri = 500 Ω | | | |
| Monitor outputs<br>Control output | (see 9.4, 9.5)<br>(see 9.10) | Output range: voltage ±10 VDC @ max 5 mA<br>current ±20 mA @ max 500 Ω load resistance | | | |
| Enable input<br>Digital inputs | (see 9.6)<br>(see 9.11) | Range: 0 ÷ 5 VDC (OFF state), 9 ÷ 24 VDC (ON state), 5 ÷ 9 VDC (not accepted); Input impedance: Ri > 10 kΩ | | | |
| Fault output | (see 9.7) | Output range: 0 ÷ 24 VDC (ON state > [power supply - 2 V] ; OFF state < 1 V ) @ max 50 mA;<br>external negative voltage not allowed (e.g. due to inductive loads) | | | |
| Alarms | | Cable break with current reference signal, over/under temperature, position control monitoring | | | |
| Position transducers power supply | | +24 VDC @ max 100 mA or +5 VDC@ max 100 mA are software selectable | | | |
| Pressure/Force transducers power supply | | +24 VDC @ max 100 mA | | | |
| Format | | Plastic box ; IP20 protection degree ; L 35 - H 7,5 mm DIN-rail mounting as per EN60715 | | | |
| Operating temperature | | -20 ÷ +50 °C (storage -25 ÷ +85 °C) | | | |
| Mass | | Approx. 450 g | | | |
| Additional characteristics | | 8 leds for diagnostic; protection against reverse polarity of power supply | | | |
| Electromagnetic compatibility (EMC) | | According to Directive 2014/30/UE (Immunity: EN 61000-6-2; Emission: EN 61000-6-3) | | | |
| Communication interface | | USB<br>Atos ASCII coding | CANopen<br>EN50325-4 + DS408 | PROFIBUS DP<br>EN50170-2/IEC61158 | EtherCAT, POWERLINK, EtherNet/IP, PROFINET IO RT / IRT<br>EC 61158 |
| Communication physical layer | | not insulated<br>USB 2.0 + USB OTG | optical insulated<br>CAN ISO11898 | optical insulated<br>RS485 | Fast Ethernet, insulated<br>100 Base TX |
| Recommended wiring cable | | LiYCY shielded cables: 0,5 mm² max 50 m for logic - 1,5 mm² max 50 m for power supply<br>Note: for transducers wiring cable please consult the transducers datasheet | | | |
| Max conductor size | (see 14 ) | 2,5 mm² | | | |

## 8 CONNECTIONS AND LEDS

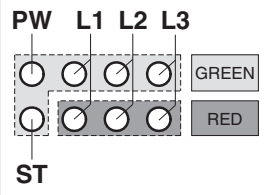



**(1)** To interface with Siemens 6ES7972-0BA12-0XA connector, it is mandatory to use also one of the following adapters to avoid interference with the USB connector: DG909MF1 - the connector will be oriented upwards; DG909MF3 - the connector will be oriented downwards

### 8.1 Diagnostic LEDs (L)

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

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



### 8.2 Connectors - 4 pin

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

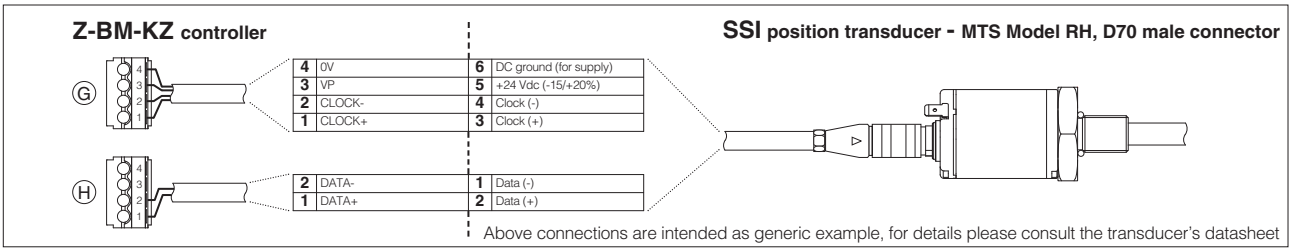
### 8.3 SSI connectors signals - 4 pin

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

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

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

**SSI connection - example**

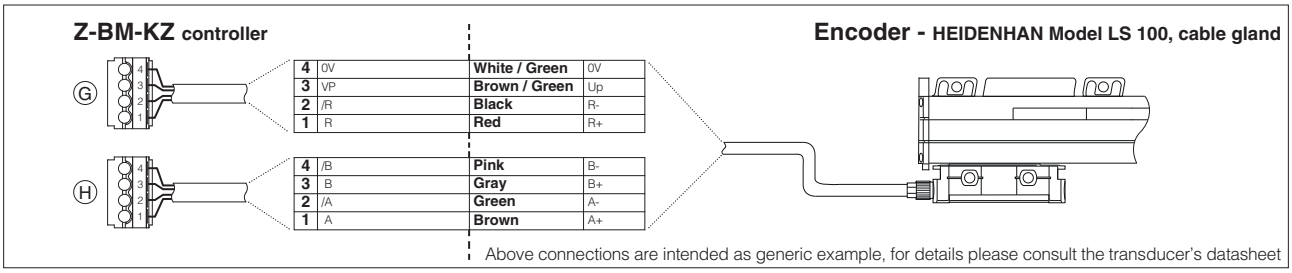



### 8.4 Encoder connectors signals - 4 pin

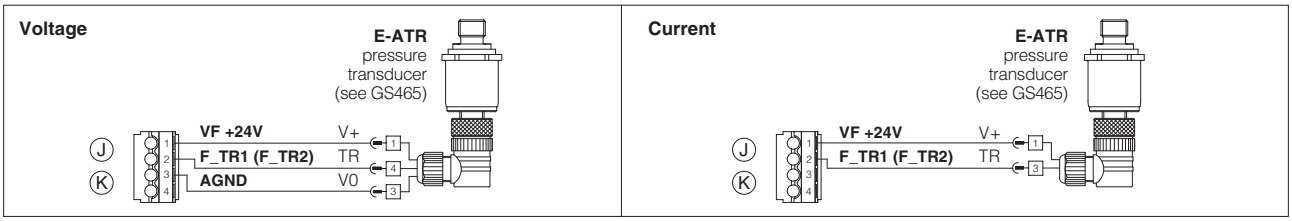
| | | | | |
|---|---|---|---|---|
| G | G1 | **R** | Input channel R | Input - on/off signal |
| | G2 | **/R** | Input channel /R | Input - on/off signal |
| | G3 | **VP** | Power supply:<br>+24VDC , +5VDC or OFF (default OFF) | Output - power supply<br>**Software selectable** |
| | G4 | **0V** | Common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

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

**Encoder connection - example**




### 8.5 Pressure/force transducers connection - example




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

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

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

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

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

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

## 9 SIGNALS SPECIFICATIONS

Atos digital controllers are CE marked according to the applicable directives (e.g. Immunity/Emission EMC Directive).
Installation, wirings and start-up procedures must be performed according to the prescriptions shown in tech table **F003** and in the user manuals included in the Z-SW programming software.
Generic electrical output signals of the valve (e.g. fault or monitor signals) must not be directly used to activate safety functions, like to switch-ON/OFF the machine's safety components, as prescribed by the European standards (Safety requirements of fluid technology systems and components-hydraulics, ISO 4413).

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

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

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

### 9.2 Position reference input signal (P_INPUT+)

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

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

### 9.3 Pressure or force reference input signal (F_INPUT+)

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

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

### 9.4 Position monitor output signal (P_MONITOR)

The controller generates an analog output signal (pin C1) proportional to the actual axis position; the monitor output signal can be software set to show other signals available in the controller (e.g. analog reference, fieldbus reference, position error, valve spool position).
The output range and polarity are software selectable within the maximum range ±10 VDC or ±20 mA; default is ±10 VDC

### 9.5 Pressure or force monitor output signal (F_MONITOR)

The controller generates an analog output signal (pin C3) according to alternated pressure/force control option:
*SN control*: output signal is proportional to the actual valve spool position
*SP, SL, SF controls*: output signal is proportional to the actual pressure/forcel applied to the cylinder's rod end
Monitor output signals can be software set to show other signals available in the controller (e.g. analog reference, force reference).
The output range and polarity are software selectable within the maximum range ±10 VDC or ±20 mA; default is ±10 VDC

### 9.6 Enable Input Signal (ENABLE)

To enable the controller, a 24 VDC voltage has to be applied on pin C2.
When the Enable signal is set to zero the controller can be software set to perform one of the following actions:
- maintain the actuator actual position in close loop control
- move towards a predefined position in closed loop control and maintains the reached position (hold position)
- move forward or backward in open loop (only the valve's closed loop remain active)

### 9.7 Fault output signal (FAULT)

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

### 9.8 Position transducer input signals

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

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

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

### 9.10 Control output signal (CTRL_OUT+)

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

### 9.11 Digital input signals (D_IN0 and D_IN1)

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

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

## 10 ACTUATOR'S TRANSDUCER CHARACTERISTICS

### 10.1 Position transducers

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

### 10.2 Pressure/force transducers

The accuracy of the pressure/force control is strongly dependent to the selected pressure/force transducer (see section 5 ). Alternated pressure/force controls require to install pressure transducers or load cell to measure the actual pressure/force values.
Pressure transducers allow easy system integration and cost effective solution for both alternated position/pressure and position/force controls (see tech table **GS465** for pressure transducers details). Load cell transducers allow the user to get high accuracy and precise regulations for alternated position/force control.
The characteristics of the remote pressure/force transducers must be always selected to match the application requirements and to obtain the best performances: transducer nominal range should be at least 115%÷120% of the maximum regulated pressure/force.

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

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

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

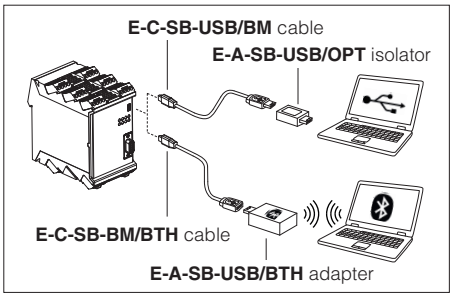
## 11 VALVE SETTINGS AND PROGRAMMING TOOLS

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

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

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

**USB or Bluetooth connection**




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

**WARNING: Bluetooth adapter is available only for European, USA and Canadian markets!**
Bluetooth adapter is certified according RED (Europe), FCC (USA) and ISED (Canada) directives

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 ; 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

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

## 12 MAIN SOFTWARE PARAMETER SETTINGS

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

### 12.1 External reference and transducer parameters

Allow to configure the controller reference and transducer inputs, analog or digital, to match the specific application requirements:
- *Scaling parameters* define the correspondence of these signals with the specific actuator stroke or force to be controlled
- *Limit parameters* define maximum/minimum stroke and force to detect possible alarm conditions
- *Homing parameters* define the startup procedure to initialize incremental transducer (e.g. Encoder)

### 12.2 PID control dynamics parameters

Allow to optimize and adapt the controller closed loop to the wide range of hydraulic system characteristics:
- *PID parameters* each part of the closed loop algorithm (proportional, integral, derivative, feed forward, fine positioning, etc) can be modified to match the application requirements

### 12.3 Monitoring parameters

Allow to configure the controller monitoring function of the positioning error (difference between actual reference and feedback) and detects anomalous conditions:
- *Monitoring parameters* maximum allowed errors can be set for both static and dynamic positioning phases, and dedicated waiting times can be set to delay the activation of the alarm condition and relevant reaction (see 12.4)

### 12.4 Fault parameters

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

### 12.5 Valve characteristics compensation

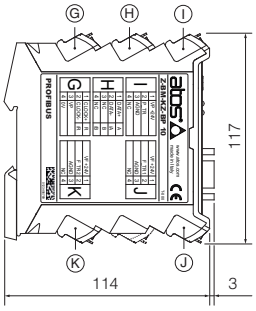
Allow to modify the valve regulation to match the actuator/system characteristics and to obtain the best overall performances:
- *Valve parameters* modify the standard valve regulation by means of deadband compensation, curve linearization and differentiated gain for positive and negative regulation

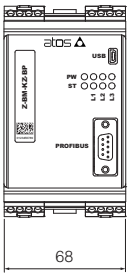
### 12.6 Motion phases parameters

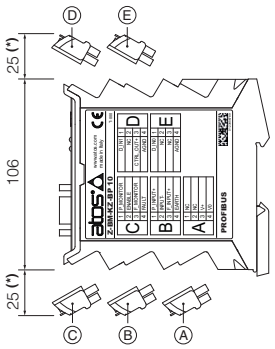
When the internal reference generation is active a pre-programmed cycle can be generated; start/stop/switch-over commands and reference generation types parameters can be set to design a customized sequence of motion phases adapted to the specific application requirements (see 4.2).

## 13 OVERALL DIMENSIONS [mm]

overall dimension with assembled connectors



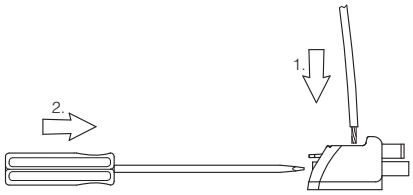

DIN rail dimensions


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

**(*)** Space to remove the connectors

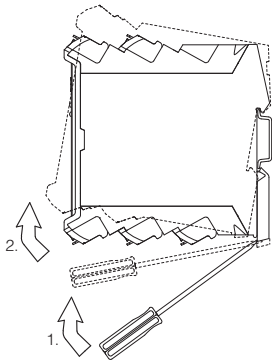
## 14 INSTALLATION

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




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

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



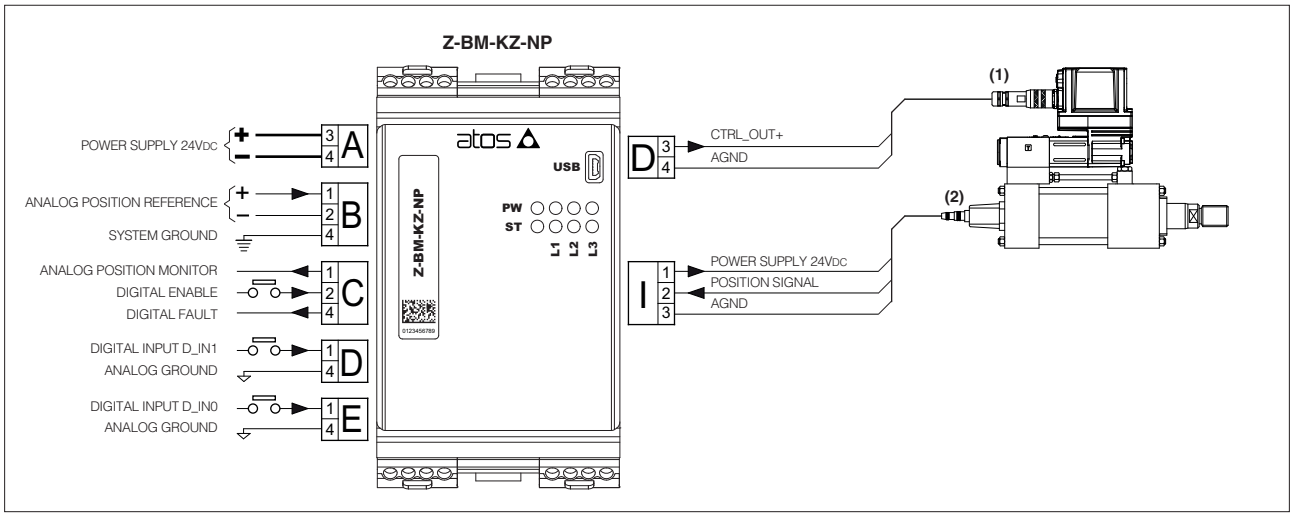

**To extract the connectors:**
1. push lever
2. pull connector


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


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

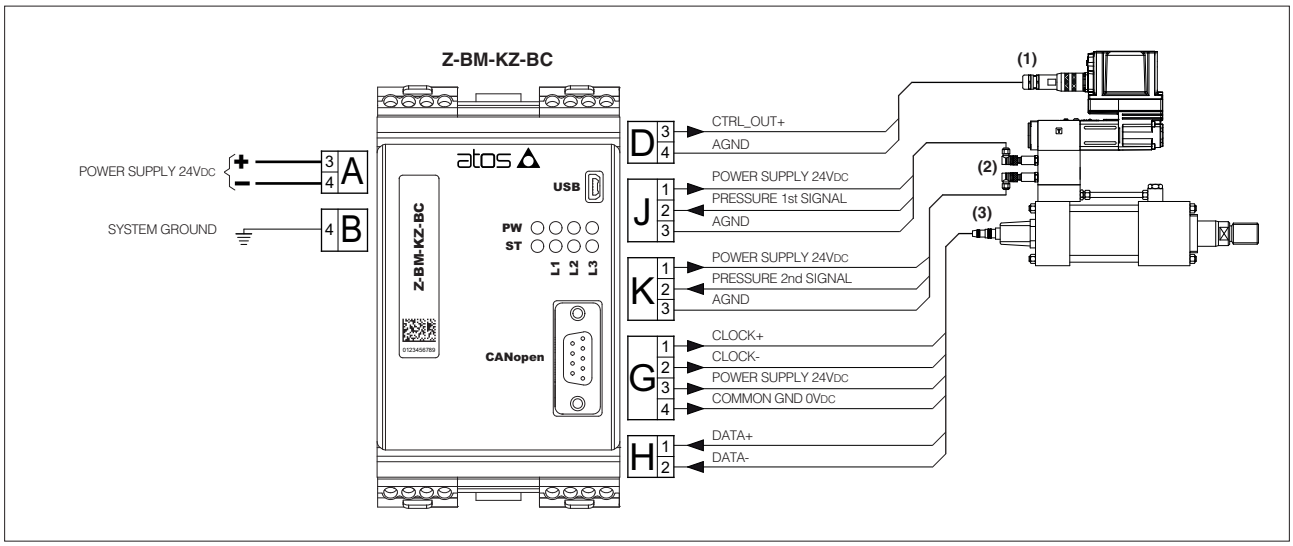
## 15 WIRING EXAMPLES

### 15.1 Position control - analog reference - analog position transducer



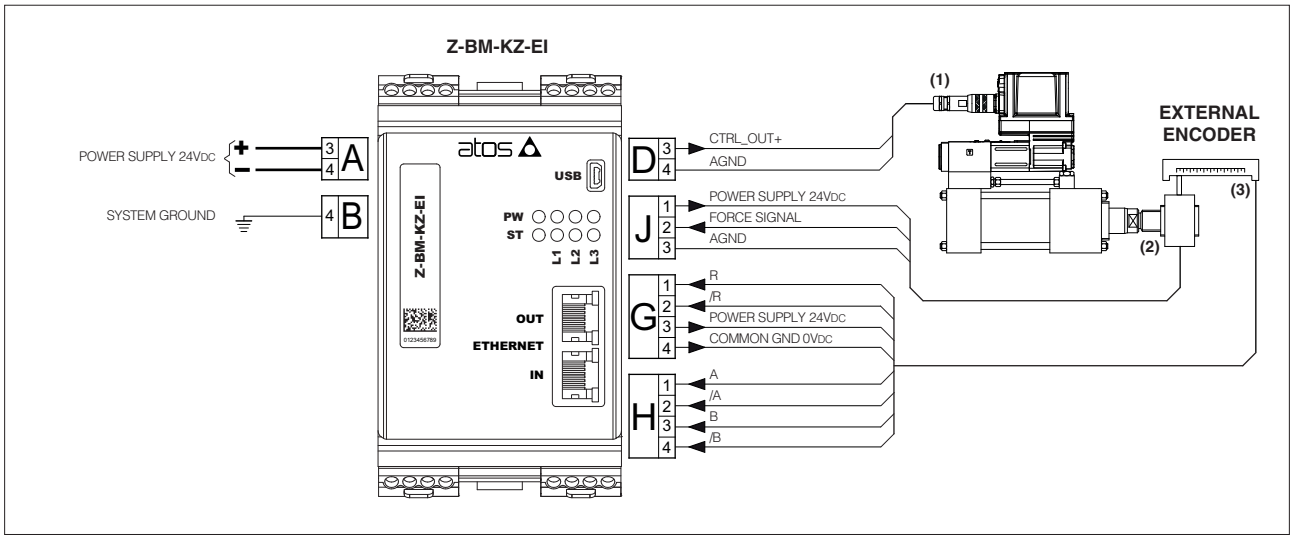

**(1)** For valve driver electrical connections please refer to the specific technical table
**(2)** The analog position transducer connections are intended as generic example, for details please consult the transducer's datasheet

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




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

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




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