New Digital Axis Motion Controllers
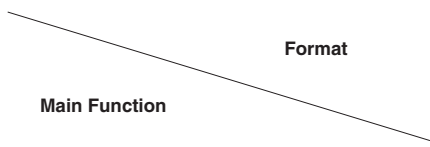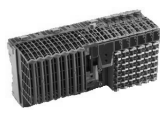
1 WHAT IS DIGITAL AXIS MOTION CONTROLLERS ?

The modern architectures of industrial machinery strongly increase the demand of accuracy, repeatability and performance.
This leads to the need of devices with complete regulations that integrate to the traditional axis positioning also the force and/or pressure controls.

Atos developments on digital electronics focus the integration of axis cards functions into proportional electrohydraulics either in integral-to valve or separate format.

New digital controllers are the up to date solution for the motion control in modern machines and systems: they can be easily configured and PC programmed to best manage, in closed loop, position, speed or force, of any electrohydraulic axis, piloted by a digital proportional valve.

They improve motion performances, simplify the automation architecture and may be interfaced by fieldbus the machine main control unit.

2 CONTROLLER SYNTHETIC COMPARISON

CONTROLLER MODEL	Z-RI-TEZ	Z-ME-KZ	Z-BM-HZ1 (HZ2)
Format / Main Function	Integral to valve	Eurocard	DIN Rail Mounting
Valve's Driver function	●		
Nr. of controlled Axis	1	1	1 (2)
Internal programmable cycles	simple	complete	extended
Graphic programming software	●	●	●
Operator Panel		●	
Position control	●	●	●
Synchronism			(●)
Position Transducer interface - Analog	1	1	1 (2)
Position Transducer interface - SSI	1	1	1 (2)
Position Transducer interface - Encoder	1	1	1 (2)
Alternate Pressure(Force)/Position control	● option	● option	● option
Pressure Transducer interface - Analog	1/2	2	1/2 (2/4)
Performance parameters setting (e.g. Dither, PID)	●	●	●
Valve parameters setting (e.g. Bias, Ramp, Scale)	● factory preset	●	●
Compensation of hydraulic system behaviour			●
Serial interface	●	●	●
CANopen fieldbus interface	●	●	●
PROFIBUS DP fieldbus interface	●	●	●
Ethernet interface			●
Digital Input	up to 2	9	12 (24) + modules
Digital Output	up to 2	8	12 (24) + modules
Auxiliary Analog Input	up to 2	6	1+modules
Auxiliary Analog Output	2	3	1+modules

▨ = alternative selection for position transducers and communication interfaces

3   **INTEGRAL-TO-VALVE CONTROLLER, TYPE Z-RI** - technical table G330

New Z-RI Atos digital controllers are integral to proportional 4-way directional valves with integral transducer, direct or pilot operated.

They perform the basic driver functions plus the position closed-loop control of the linear/rotative actuator to which the proportional valve is connected, see hydraulic sketch at side.

The selection of the electronic interface for one of the following position transducers, integral or external to the actuator, is required in the controller's code:

- potentiometer analog   (voltage signal)
- magnetosonic analog   (voltage or current signal)
- magnetosonic digital   (SSI serial interface)
- linear or rotative encoder digital   (TTL signal logics)

Two main functional command modes can be selected by software:

- real time external reference input – analog or digital by fieldbus communication
- internal reference generation of simple motion profiles, programmable by Atos PC software and sequenced by the external machine central unit using on-off inputs

Available interfaces:

- up to 2 analog input for reference command signals, position (default) and pressure if SP/SF/SL executions are selected
- up to 2 analog output for monitor, position (default) and optionally pressure (SP/SF/SL executions)
- up to 2 on-off input for logic communication with the machine electronic control unit: selection of motion sequences and inhibit command in front of machine alarm situation
- up to 2 on/off output for controller fault detection and axis status diagnostics
- 1 communication interface (Serial, CANopen or PROFIBUS DP)

Additional functionalities:

- full software setting of the controller including the compensation of the main hydraulic system characteristics, closed-loop PID gains and max error windows
- electronic compensation function for actuator's seals friction
- separate power supply for the controller circuit and for the solenoid output stage, to allow the safety emergency stop of the axis while maintaining active the controller and the field-bus communication with the machine central unit
- SP/SF/SL executions are available, to combine pressure or force closed-loops to the original position control: in this case additional interfaces are available for connection of load cell or 1-2 pressure transducers
- real time oscilloscope function to dynamically analyze the valve and axis performances
- detailed diagnostics of the axis status, faults and performance
- software setting of safety predefined procedures in case of faulty conditions

The digital valve with integral Z-RI axis controller can be delivered already assembled on Atos servocylinder and wired to the relevant transducer, to realize a smart motion units, called "Servoactuator".

This execution speed up the installation and the start-up of the electrohydraulic axis and simplify the overall machine control architecture.

The integral construction and the fixed number of electrical interfaces may involve customizing of the mechanics, firmware and software, thus requiring technical cooperation with leading customers, a detailed presales analysis is ever required.

In the sketch at side are shown two typical examples of Z-RI applications:

Parison

The Parison servoactuator integrates the 4-way servoproportional valve with Z-RI controller, to manage the position closed-loop control of the parison axis in plastic blow molding machines; the machine electronic central unit supplies in real time the position analog command signal to the controller and obtain the parison actual position by the controller's monitor analog interface.

Sheet Punching

The controller is integrated on a pilot operated 4-way directional valve to manage the punching axis position. It generates the motion sequences and the relevant closed-loop control. The machine electronic central unit synchronizes punching and sheet movements through the controller's on-off interface: input (start a new cycle) and output (cycle ended).
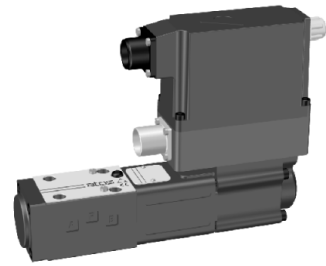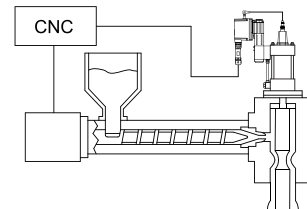

**Proportional valve
with integral Z-RI controller**
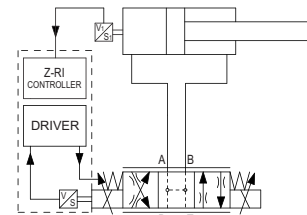
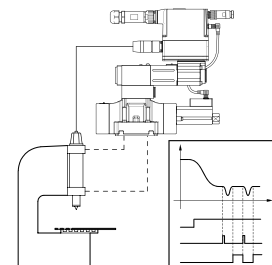**4-way directional valve
Position control**
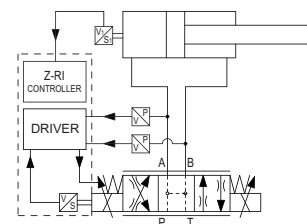
**4-way directional valve
Position / Force control**

Parison Control

Punching Axis

legend:

    pressure transducer

    valve position transducer

    cylinder position transducer

New Z-ME-KZ Atos controllers are axis cards conforming to the latest development of modern automation technology, designed for electrohydraulic applications.

The Eurocard execution of this controller extends the quantity of available electronic interfaces and functionalities thus obtaining a more flexible and general purpose hydraulic motion control unit.

These controllers must be interfaced to a 4-way proportional directional valve, analog or digital, connected with the actuator to be controlled. They generate an analog voltage/current signal to command the valve's electronic driver.

To realize the position control, they require the connection to the actuator's position transducer, integral or external type. This axis card can be interfaced with any of the transducers available for the Z-RI controllers without any selection requirement.

Available interfaces:

- 6 analog input   (voltage or current, software selectable)
- 3 analog output   (voltage or current, software selectable)
- 9 on/off input   (1 enable + 8 programmable)
- 8 on/off output   (1 status + 7 programmable)

The above interfaces are all simultaneously available to allow communication with the machine control unit for sequencing of the internal generator, axis inhibit in case of machine alarm situation, diagnostics, etc.

They can also be connected to auxiliary transducers (e.g. temperature) or dedicated to the management of auxiliary valves to realize safe system configuration in case of failure or alarm.

Additional functionalities are the same of Z-RI-TEZ plus:

- dedicated RS232 interface for connection with Atos PC programming software
- separate communication interface for fieldbus: CANopen or PROFIBUS DP
- front panel display and buttons for quick operation of parameter programming and diagnostic without requiring the PC software
- advanced internal generation of motion profiles

Pressure or force closed-loop controls can be combined to the main position control by simple software setting. In this case additional pressure transducers or load cell have to be installed in the hydraulic system and connected to the relevant analog interfaces available on the controller, see sketch at side.

The Z-ME-KZ axis cards are particularly indicated for motion control of a single axis with multiple interfacing to the machine auxiliary subsystems, like proximity sensors and safety valves/circuits, manual commands by operators during start up and emergencies, management of motion sequences coordinated with other axis.

Thanks to the flexible general purpose controller's structure and to the Atos easy PC programming software, the Z-ME-KZ axis cards can be simply adapted and optimized by distributors or customers to any specific application.
Dedicated trainings will be available for customers to get acquainted with innovative solutions.

For standard and repetitive applications with requirements of integration with machine automation and high number of interfaces, the Z-ME-KZ axis cards can be directly supplied by Atos to leading OEMs with firmware and software customized to their specific application requirements; in these cases a detailed presales analysis is strictly required.

Z-ME-KZ controller

Machine
Central
Unit

**4-way directional valve
Position control**

Machine
Central
Unit
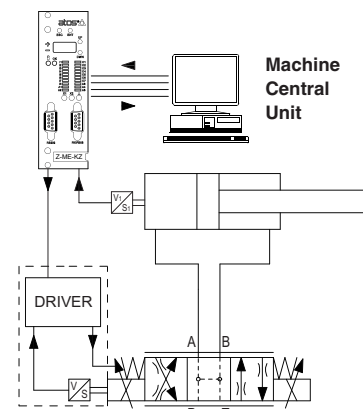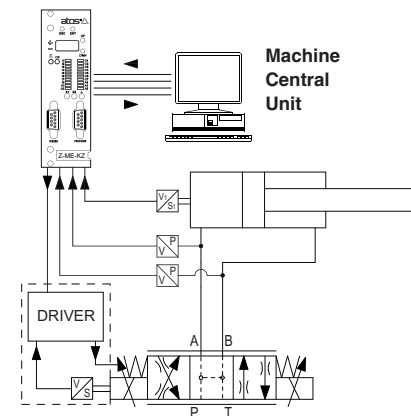
**4-way directional valve
Position / Force control**

legend:

 pressure transducer

 valve position transducer

 cylinder position transducer

5 **SEPARATE DIN-RAIL CONTROLLER, TYPE Z-BM-HZ** - technical table G350

New Z-BM-HZ Atos controllers are powerful high performances axis cards with modular assembling on DIN Rail panel support.

Their basic functions are similar to the Z-ME-KZ controllers but thanks to the extended computation capabilities they can control up to two hydraulic axes with independent or synchronized motion cycle.

The Z-BM-HZ modular design permit to widely configure the on-off and analog interfaces according to the specific application requirements and to manage also an unlimited number of auxiliary logics like proximity sensors, safety valves and circuits, manual commands by operators during start up and emergencies, management of motion sequences coordinated and/or synchronized with other axes.
The motion cycle can be programmed into the axis card with many motion commands and functions, alternating many different control loops (position, speed, acceleration and force) contemporary active on the electrohydraulic axis.

The valve regulation characteristics (linear, progressive, etc,), the cylinder size and area ratio and many other physical system's characteristics can be directly set into the controller, which will then automatically compensate their effect on the motion control performances.

The Atos Z-BM-HZ digital controller completes the Atos top range of the electrohydraulic motion control units.

The following scheme represents a typical application of Z-BM-HZ2 ① controller performing a 2 axis synchronous motion control with limitation of the actuator's maximum force; one of the actuators is defined Master and the other Slave.

The Atos controller internally generates in real time a motion profile (position/time ②①) for the Master actuator and the max force reference (force/time ②②) for both axes; position feedback of the Master axis is then used as position reference for the Slave actuator.
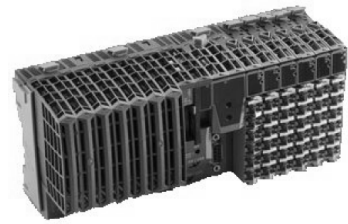
All motion profiles can be easily programmed and stored by means of Z-SW-HZ Atos unique PC software.

The feedback values, measured by the cylinder's position and the pressure transducers installed on the system, are processed to the input interfaces of Z-BM-HZ.
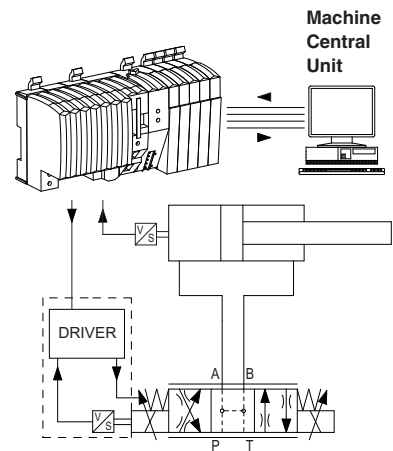
The internal processing unit runs, per each actuator, a position/speed PID closed-loop with alternate force control (PA-PB): the CPU compares the internally generated position/force references with the relevant input feedbacks and the deviations are elaborated by PID algorithm to work out the reference command signal for the electronic driver of the proportional valve ③① and ③② .

The alternate force control is active during the whole motion cycle and it is activated if PA-PB reaches its max reference value.

In case the force limitation is activated on the Slave axis, this last immediately becomes Master thus avoiding possible misalignment between the 2 actuators.

Z-BM-HZ controller

Machine Central Unit

4-way directional valve Position control

legend:

①	Z-BM-HZ2 controller
②.1	position/time profile
②.2	force/time profile
③.1 ③.2	4-way directional valve
④.1 ④.2	double acting cylinder
V/P	pressure transducer
V/S	valve position transducer
V1/S1	cylinder position transducer