

Digital Axis Motion Controllers

1 WHAT IS DIGITAL AXIS MOTION CONTROLLER ?




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.

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 TYPE	INTEGRAL AXIS CONTROLLER	AXIS CONTROLLER	PLASTIC INJECTION CONTROLLER
	 Integral to valve	 Eurocard	 Eurocard
Valve's Driver function	●		
Nr. of controlled Axis	1	1	1
Internal programmable cycles	simple	complete	injection
Graphic programming software	●	●	●
Operator Panel		●	●
Position control	●	●	
Velocity control			●
Plastic injection closed loop control			●
Analog Position Transducer interface - Analog / Potentiometer	●	●	●
Digital Position Transducer interface - SSI / Encoder	●	●	●
Alternated control	● option	●	●
Pressure Transducer interface - Analog	2	2	2
Performance parameters setting (e.g. Dither, PID)	●	●	●
Valve parameters setting (e.g. Bias, Ramp, Scale)	● factory preset	●	●
USB interface	●		
Serial interface		●	●
CANopen fieldbus	●	●	●
PROFIBUS DP fieldbus	●	●	●
EtherCAT fieldbus	●		
POWERLINK fieldbus	●		
EtherNet/IP fieldbus	●		
Digital Input	up to 3	9	8
Digital Output	up to 2	8	8
Auxiliary Analog Input	up to 2	6	6
Auxiliary Analog Output	2	3	3

 = alternative selection for position transducers and communication interfaces

3 DIGITAL PROPORTIONALS WITH INTEGRAL AXIS CONTROLLER - tech table FS230

Digital electronics include valve's driver + axis controller to perform the position closed loop of any linear or rotative hydraulic actuator.

They are integrated to direct or pilot operated directional proportionals and operated by an external or internally generated reference position signal.

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:

Analog:

- potentiometer (voltage signal)
- magnetosonic (voltage or current signal)

Digital:

- magnetosonic (SSI serial interface)
- linear or rotative encoder (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 (S option)
- up to 2 analog output for monitor, position (default) and optionally pressure (S option)
- 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
- USB communication interface (always present)
- IN / OUT fieldbus communication interface (CANopen, PROFIBUS DP, EtherCAT, POWERLINK or EtherNet/IP)

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 fieldbus communication with the machine central unit
- S option is available, to combine pressure or force closed-loops to the original position control: in this case additional interface is 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
- LEDs for controller operative conditions
- software setting of safety predefined procedures in case of faulty conditions

The digital valve with integral 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 integral axis controller applications:

Parison

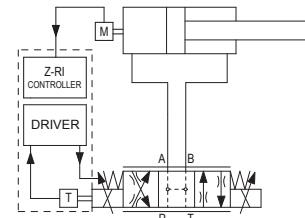
The Parison servoactuator integrates the 4-way servoproportional valve with integral axis controller, to manage the position closed-loop control of the parison axis in plastic blow molding machines; the machine electronic central unit supplies in real time the position analog command signal to the controller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

Sheet Punching

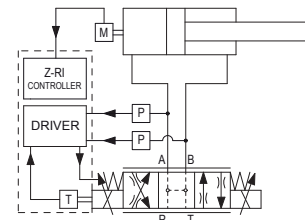
The controller is integrated on a pilot operated 4-way directional valve to manage the punching axis position. It generates the motion sequences and the relevant closed-loop control. The machine electronic central unit synchronizes punching and sheet movements through the controller's on-off interface: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



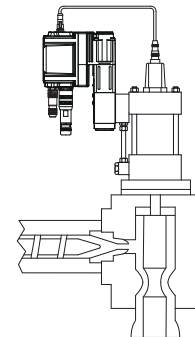
Proportional valve with integral axis controller



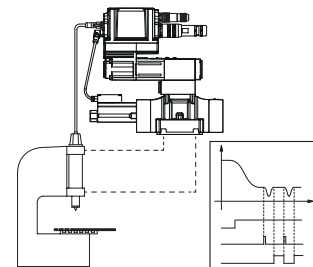
4-way directional valve Position control



4-way directional valve Position / Force control



Parison Control



Punching Axis

Legend:

- P** pressure transducer
- T** valve's spool transducer
- M** actuator's position transducer

4 EUROCARD AXIS CONTROLLER - tech table G340

The axis controllers in Eurocard format extend 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 perform the position control, they require the connection to the actuator's position transducer, integral or external type. These controllers can be interfaced with any of the transducers available for the digital proportionals with integral axis controller (see section 3) and selectable by software.

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 integral axis controller (see section 3) 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.

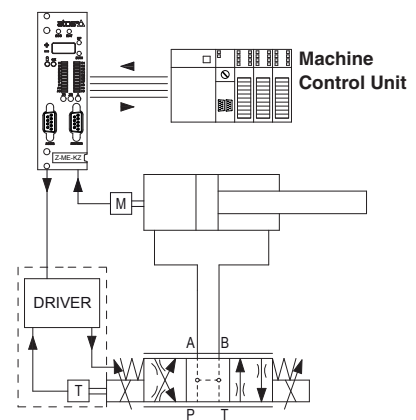
The Eurocard axis controllers are particularly indicated for motion control of a single axis with multiple interfacing to the machine auxiliary subsystems, like proximity sensors and safety valves/circuits, manual commands by operators during start up and emergencies, management of motion sequences coordinated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

Thanks to the flexible general purpose controller's structure and to the Atos easy PC programming software, the Eurocard axis controllers can be simply adapted and optimized to any specific application.

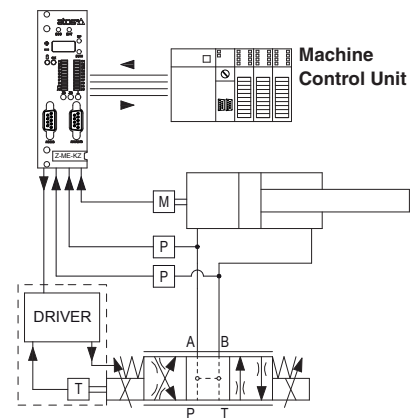
For standard and repetitive applications with requirements of integration with machine automation and high number of interfaces, the Eurocard axis controllers can be directly supplied by Atos to leading OEMs with firmware and software customized to their specific application requirements; in these cases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



Eurocard axis controller



**4-way directional valve
Position control**



**4-way directional valve
Position / Force control**

Legend:

- P** pressure transducer
- T** valve's spool transducer
- M** actuator's position transducer

5 EUROCARD PLASTIC INJECTION CONTROLLER - tech table G345

The plastic injection controllers in Eurocard format are dedicated for electrohydraulic closed loop controls of injection in plastic presses.

These controllers perform velocity and force closed loop controls, according to real time commands (analog or fieldbus) generated by machine control unit (e.g. PLC). The machine control unit manages whole the injection process (Injection, Pack and Hold, Decompression, Back Pressure) through dedicated digital commands or fieldbus communication.

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 velocity control, they require the connection to the actuator's position transducer, integral or external type. These Eurocard controllers can be interfaced with any of the transducers available for the digital proportionals with integral axis controller (see section [3]) and selectable by software.

Available interfaces:

- 6 analog input (voltage or current, software selectable)
- 3 analog output (voltage or current, software selectable)
- 8 on/off input (1 enable + 2 programmable + 5 pre-configured to manage of the injection process)
- 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 generation of injection cycle, axis inhibit in case of machine alarm situation, diagnostics of the injection status, etc.

Additional functionalities:

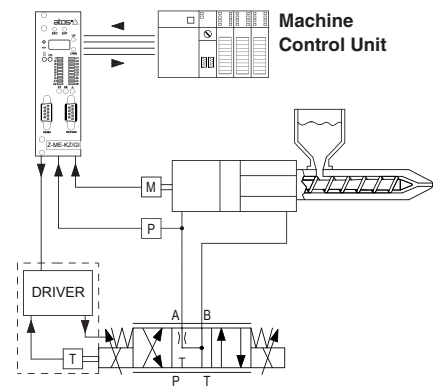
- internal generation of injection cycle
- monitoring of injection process
- diagnostics of the injection status
- advanced internal generation of motion profiles

Remote pressure transducers have to be installed close to the injection actuator and connected to the controller, see sketch at side.

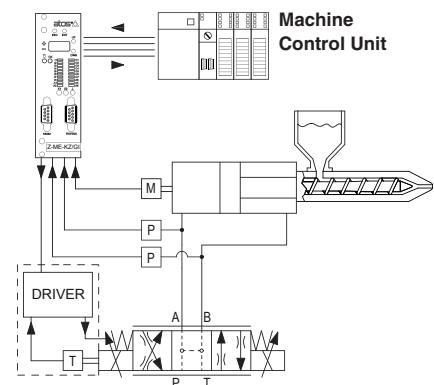
Thanks to the flexible controller's structure and to the Atos easy PC programming software, these Eurocard controllers can be simply adapted and optimized for plastic injection application.



Plastic injection controller



**4-way directional valve
Alternated Velocity/Pressure Control**



**4-way directional valve
Alternated Velocity/Force Control**

Legend:

- P** pressure transducer
- T** valve's spool transducer
- M** actuator's position transducer